ASTM Bulletin

NOTE! WEST COAST MEETING

Los Angeles September 16–22, 1956

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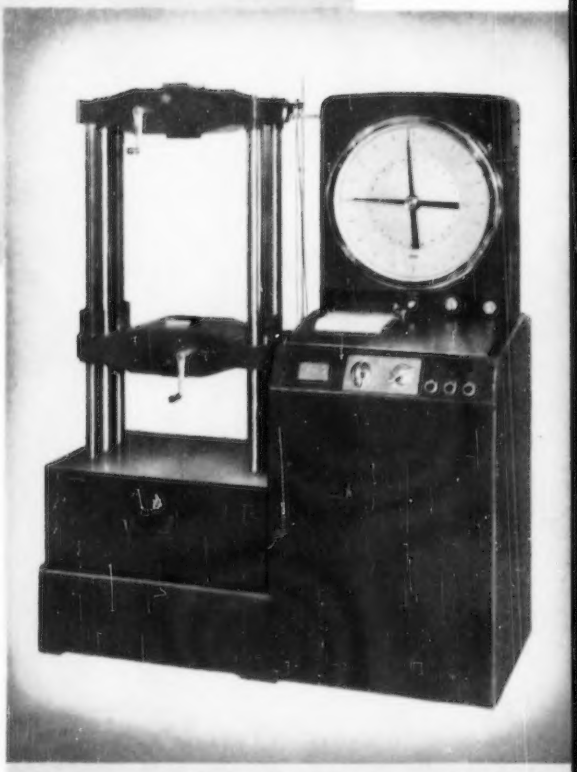

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DECEMBER 1955

Number 210

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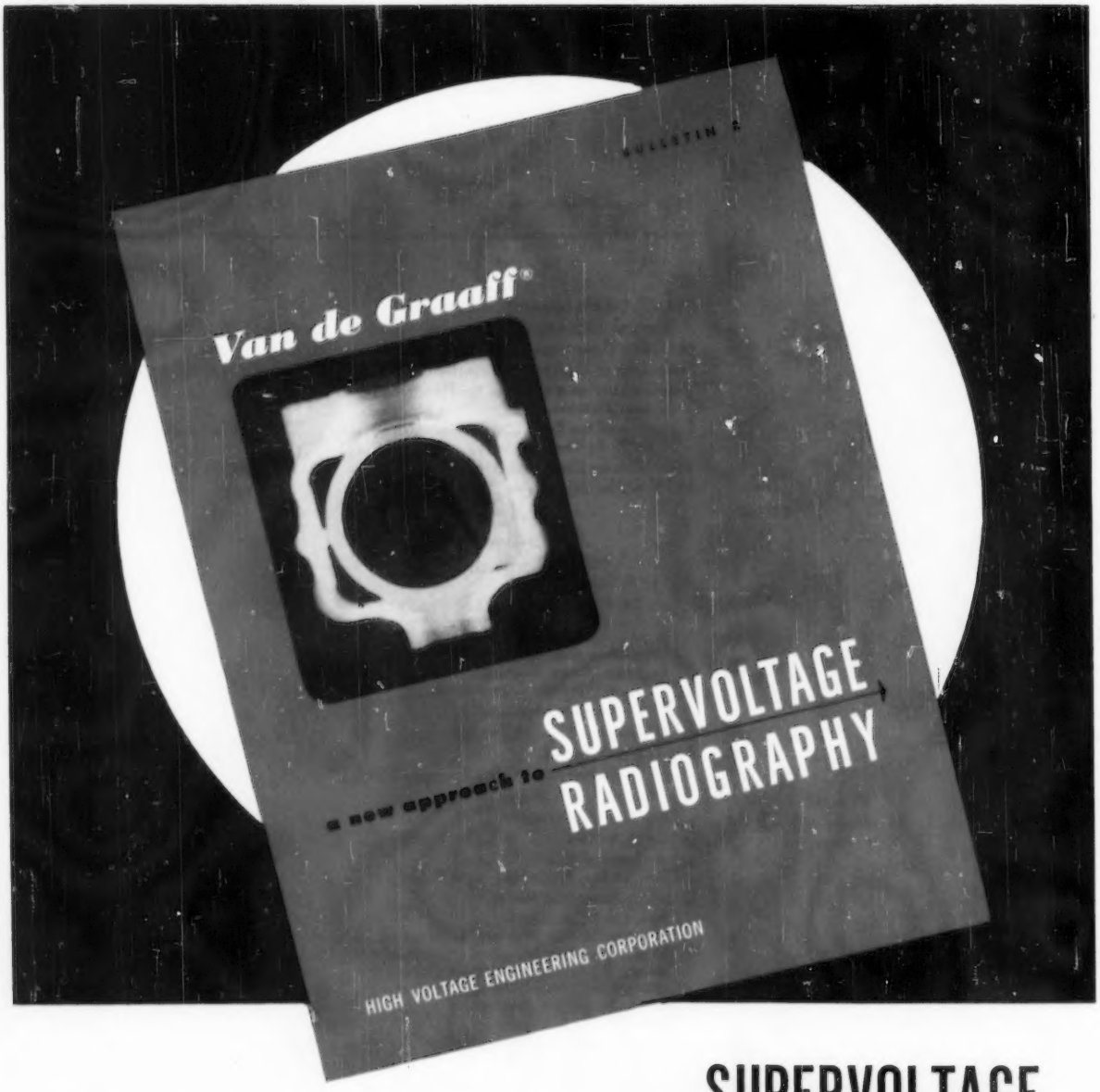

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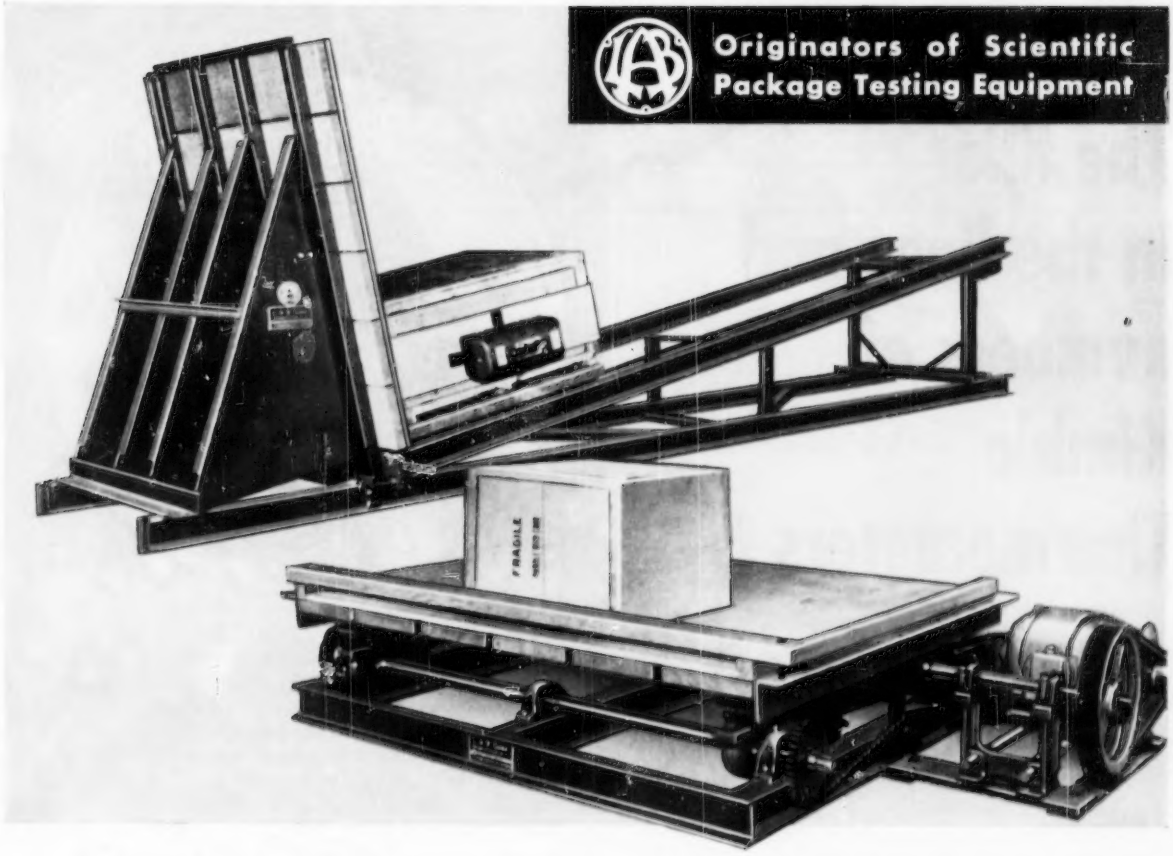

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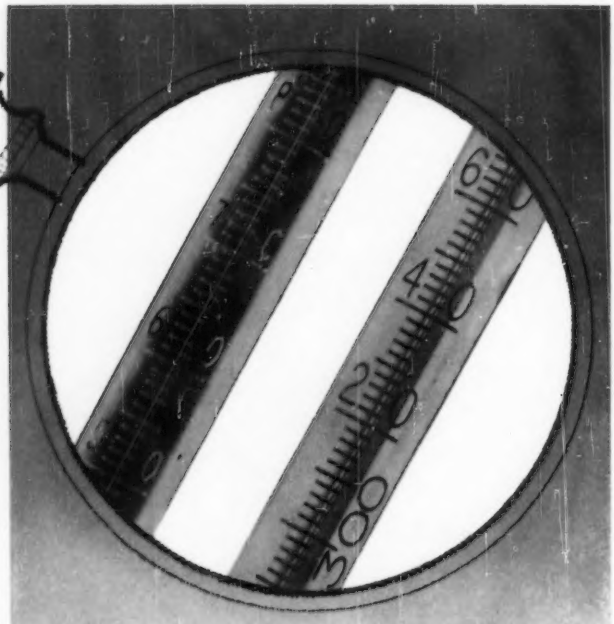

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Scheduling Trips in 56? Include the

ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

Number 210 December, 1955

NATIONAL MEETINGS

Symposium on Plated Coatings at Buffalo

Part of 1956 Committee Week— Hotel Statler—February 27 to March 2

A SYMPOSIUM on Properties, Tests, and Performance of Electrodeposited Metallic Coatings will provide a change of pace in the tight 5-day schedule of technical committee meetings known as ASTM Committee Week.

The Hotel Statler in Buffalo, N. Y. will provide the facilities for more than 250 meetings of main committees and their subgroups from February 27 to March 2.

The two-session symposium, arranged for Wednesday, February 29, by Committee B-8 on Electrodeposited Metallic Coatings will be of special interest to executives, engineers, and technicians involved in the production, testing, and use of plated coatings.

The eight papers comprising the morning and afternoon sessions will cover a variety of subjects including a summation of performance data obtained from testing various combinations of copper-nickel-chromium, also lead, cadmium, and zinc coatings and chemical conversion coatings of the latter metals. The papers will also give consideration to such matters as metal cleaning procedures, evaluation of the salt-spray test method, and work related to certain physical properties of plated coatings.

Titles and authors of the symposium papers are as follows:

Introduction by Symposium Chairman W. L. Pinner, Houdaille-Hershey Corp.

History of ASTM Committee B-8 by William Blum, formerly National Bureau of Standards

Corrosion Behavior and Protective Value of Decorative Copper-Nickel-Chromium and Nickel-Chromium Coatings on Steel by C. H. Sample, International Nickel Co.

Evaluation of Methods Available for Measurement of Surface Luster in Plated Coatings by Glade Bowman, Rockwell Spring and Axle Co.

Metal Cleaning Prior to Electroplating by S. Spring, Pennsylvania Salt Manufacturing Co.

Comparison of the Corrosion Behavior and Protective Value of Electrodeposited Zinc and Cadmium Coatings on Steel by C. H. Sample and R. B. Tell, International Nickel Co., and A. Mendizza, Bell Telephone Laboratories.

Evaluation of Supplementary Conversion Coatings on Zinc and Cadmium by R. E. Harr, Western Electric Co.

Atmospheric Exposure of Electroplated Lead Coatings on Steel by A. H. DuRose, Harshaw Chemical Co.

The Standard Salt-Spray Test—Is it a Valid Acceptance Test? by A. Mendizza, Bell Telephone Labs.

Ample time for discussion of each paper will be allowed.

Attention, Photographers!

ASTM ANNUAL MEETING

ATLANTIC CITY ***JUNE 18–22, 1956***

ASTM WILL HOLD its 1956 Photographic Exhibit in connection with the 59th Annual Meeting at Atlantic City, June 18–22, 1956. As in past years, the theme will be **materials, testing, and research.** Photographs featuring apparatus, instruments, processing techniques, testing, standards, and related items are invited. Photographs showing unique or unusual applications of materials are welcome as well as those featuring the human element. Entries will be accepted in the following classifications:

- **General**
  - Black and white or monochrome prints
  - Color prints
  - Color transparencies
  - Student
- **Photomicrographs**
  - Black and white or monochrome prints
  - Color prints
  - Color transparencies
  - Student
- **Electron micrographs**

Any photograph made by an ASTM member or an employee of a member company is eligible for display. Complete information and application forms will be sent to members shortly after the first of the year. In the meantime, you can begin planning and working toward an award-winning display.

Scheduling Trips in 56? Include the

ASTM PACIFIC AREA NATIONAL MEETING

LOS ANGELES — SEPTEMBER 16-22, 1956

As PLANNING for the Second Pacific Area National Meeting moves into high gear, all signs point to a big, productive, and varied program, fully in keeping with the vigorous and expanding economy of the West Coast.

In addition to the technical sessions—always the heart of an ASTM meeting—an Exhibit of Testing and Scientific Apparatus will run concurrently with the meeting at Los Angeles' Statler Hotel. Also on the anvil is a series of Industry Luncheons, patterned after the highly successful ones held during the first Pacific Area Meeting in 1949. At each of the six projected luncheons, engineers, technicians, and executives from certain industries or areas of technical activity (such as paint, petroleum, cement) will meet for exchange of ideas, fellowship, and to hear a prominent and authoritative speaker.

Further news of this meeting, the technical program, and related events, will appear in subsequent BULLETINS. **In the meantime, plan now to attend this meeting in the fall of '56.**

Downtown Los Angeles—the well-known Wilshire Boulevard crossing Mac Arthur Park in the foreground.

Government-Industry Cooperation and Standards Stressed at National Conference

AT THE three-day conference on standards sponsored jointly by the American Standards Association and the National Bureau of Standards, October 24–26, the many addresses and papers presented by leading authorities stressing the advantages of Government-industry cooperation in standardization, give definite evidence of the remarkable progress that has been made during the past 18 months in implementing this very worthwhile endeavor.

On the program were a number of members of ASTM including Past-Presidents John R. Townsend and Norman L. Mochel. Mr. Townsend presented the industry point of view in the session dealing with the Office of Secretary of Defense Level; Mr. Mochel spoke for the Society and societies generally in the session on Industry-Government Specifications which was sponsored by the General Services Administration, National Institute of Governmental Purchasing and the Conference of Executives of Organization Members of the ASA. This session was sparkplugged by Lester W. Benoit, Executive Secretary of the Manufacturers Standardization Society of the Valve and Fittings Industry, who is chairman of the CEOM. ASTM Executive Secretary Painter is a vice-chairman of this Conference.

Throughout the sessions many references were made to ASTM and its outstanding standardization activities, many of which tie in closely with the work of the National Bureau of Standards and the American Standards Assn.

High honor was done to another ASTM Past-President, J. G. Morrow, Steel Company of Canada, who received the Standards Medal. This medal recognizes leadership in the actual development and application of standards.

The many significant addresses included a group on the legal implications of standardization. Of special interest to the Society were the discussions by Edmund F. Mansure, Administrator of the General Services Administration, and his associate, Willis S. MacLeod, Director of Standardization Division, General Services Administration. The presiding officer of this session was C. E. Mack, Commissioner, Federal Supply Service, General Services Administration.

A list of the session topics is given below. It is expected that one or more of these papers will be published in the January issue of the ASTM BULLETIN.

Session Topics:

The Legal Implications of Standardization
Government-Industry Standardization at the Office of Secretary of Defense Level
Government-Industry Standardization at the Army, Navy, and Air Force Level
The Relationships of Industry Standards and Specifications to Those of Government
Government-Industry Coooperation in International Standardization

Complete proceedings of the Conference will be published by the ASA. Orders should be sent to its headquarters, 70 E. Forty-fifth St., New York 17, N. Y.

Report on Significance of

a result, features that were of little or no concern a few years ago enter into

annually by ASTM and Battelle Memorial Inst. and is presented at the

NEW ASTM PUBLICATIONS

1955 Book of ASTM Standards—Part 1—Ferrous Metals

With the publication of Part 1—Ferrous Metals of the 1955 Book of ASTM Standards, the first part of the Society's most important publication goes to work for industry. Typical of all Parts of the 1955 Book, this edition of Part 1 contains more standards and more pages than the 1952 edition. Of the 315 standards and tentatives in Part 1, 125 are new or have been revised since the 1954 supplement was published a year ago. Since 1952, 211 of the 315 are new or have been revised.

The entire Book of Standards (7 Parts) is estimated to contain 11,714 pages and more than 2200 standards, an increase in size of 17½ per cent over the 1952 edition. With each Part larger and containing more standards than ever, members will get even more value for their membership dues dollar.

Part 3 Cement, Concrete Aggregates, Thermal Insulation, Road Materials, Waterproofing and Soils, is scheduled for publication next and should be in the mails by the time this Bulletin reaches ASTM members. It will be followed closely by Part 2—Non-Ferrous Metals, and Part 5—Fuels, Petroleum, Aromatic Hydrocarbons, and Engine Antifreezes. Parts 4, 6, and 7 will be published as rapidly as editorial and press work can be completed, with the last Part expected off the presses about the first of February.

The 1952 edition for the first time was printed on bible paper to conserve weight and shelf space. The 1955 edition will be printed on bible paper of greater firmness and opacity to produce an even better book than the previous edition where the printing showed through the page slightly—a not too objectionable but somewhat undesirable result of our first experience with bible paper.

The reference value of the Book of Standards cannot be overemphasized. Although in many circumstances one or two Parts of the Book of Standards pertaining to the specialty of the engineer or corporation may be adequate for 90 per cent of the problems which arise, having a complete book on hand for the other 10 per cent would be of great value and justify the relatively few more dollars spent annually to obtain a complete set.

Members receive on their membership any one Part and its Supplements without extra charge. Many have elected to receive on a continuing basis two, three, or more Parts and Supplements at an annual charge of $3 per Part. About 40 per cent of our members get all seven Parts. The members' instructions in this regard are kept on file at ASTM Headquarters and shipments of the Book of Standards and its Supplements are made automatically against these instructions. Members also have the privilege of buying extra copies at prices considerably under the list price.

Considerable extra effort has been devoted to make the Book of Standards available earlier this year than usual. Printing was begun as soon as possible in September after the return of ballots ratifying standards adopted at the 1955 Annual Meeting. According to the printer's estimate, it will take three presses working 16 hours a day a total of four months to print the book, the equivalent of one high-speed press working two shifts a day for a year.

The Society is investing about $235,000 in the actual printing and distribution—and this is but a small portion of the total dollar value of the time and effort and research and knowledge and experience which go into the development of standards comprising the book.

But, as with any investment—machines, tools, buildings, industrial plants—the Book of Standards becomes valuable only as it is used. Its wide distribution and use throughout the world and especially in the United States and Canada is a source of gratification to the technical committee men who have given so generously of their time and thought and effort in producing standards.

The Book of Standards can be as valuable and useful as it is only because of the confidence placed in its reliability. Again credit is due the committees for their constant vigilance in keeping abreast of the needs in all fields of materials for new standards and for revisions of existing standards to see that they keep in accord with progress and that new ones are added to fill the gaps which may become evident as new techniques and materials come into being.

Production executives, materials engineers, designers, architects, purchasing agents and all others concerned with specifying engineering materials should bring their references to ASTM standards up to date. In doing this they will benefit from the combined knowledge and experience of the thousands of volunteer authorities who make up ASTM and serve on its committees.

The 1955 Book of Standards includes all of the ASTM specifications, tests, definitions, recommended practices, etc., (except ASTM Methods for Chemical Analysis of Metals which are published in a separate volume—1950) in their latest approved forms. Notices of availability and order blanks have been sent to all members, committee members, and purchasers of the book in past years. Those buying the books (not to be confused with books sent on standing instructions) who have sent in their orders will have their books mailed to them directly from the printer as rapidly as possible after publication.

1955 Book of Standards Prices

		*Members for Extra Copies**	*Nonmembers*
Part 1	Ferrous Metals	$10.00	$13.50
Part 2	Non-Ferrous Metals	8.50	11.00
Part 3	Cement, Concrete, Ceramics, Thermal Insulation, Road Materials, Waterproofing, and Soils	10.00	13.50
Part 4	Paint, Naval Stores, Wood, Fire Tests, Sandwich Constructions, Building Constructions	8.50	11.00
Part 5	Fuels, Petroleum, Aromatic Hydrocarbons, and Engine Antifreezes	8.50	11.00
Part 6	Electrical Insulation, Electronic Materials, Plastics, Rubber	9.00	13.00
Part 7	Textiles, Soap, Water, Paper, Adhesives, and Shipping Containers	8.50	11.00
Complete Set		63.00	84.00

* Each member gets one selected Part on his membership and can procure the other Parts and Supplements at an annual charge of $3 per Part.

Report on Significance of Tests of Concrete and Concrete Aggregates

THIS publication, the culmination of several years of concerted effort in Committee C-9 on Concrete and Concrete Aggregates, is a worthy successor to the previous Reports of 1935 and 1943. Coverage has been considerably broadened by discussion of the significance of properties as well as of the tests themselves.

Often certain recognized properties of materials are not amenable to measurement and expression in fundamental physical units and in some cases direct measurement may not be practicable at all. As a result, many arbitrary and empirical methods of test have become standards upon which the merits of some materials are judged. Within themselves these do not vitiate the effort or hinder evaluation of the materials; the hindrance arises only when the limitations as well as the applications of the results are not realized—when the significance of the test is not known. Likewise, tests for certain properties of a material may be established and performed needlessly if the properties that are evaluated have no significance in the end use of the material.

Subject matter of the Report has been divided into four principal groups, starting with those of a general nature, continuing with tests of concrete followed by tests of concrete aggregates, and closing with tests of other materials having a direct bearing on some uses of concrete.

The first group shows viewpoints basic to all evaluations of concrete: aspects of sampling, the role of statistical methods, and an analysis of present research needs.

The section on tests is subdivided into freshly mixed, hardened, and special categories of concrete. The last named included ready-mixed and lightweight concretes and aggregates. Among the first subdivision group are two timely papers on setting time and air content; about 50 per cent of the hardenability group is comprised of subjects not before treated in this publication, such as petrographic examination, thermal properties, bond with reinforcing steel, resistance to chemical attack, fire, and radiation; resistance to weathering is given greatly enlarged treatment.

A broad picture of the significant properties of concrete aggregates is provided in the third section. Long-standing methods of tests are reviewed in the light of the properties measured, and, as a result, features that were of little or no concern a few years ago enter into the discussion of veteran subjects, such as surface area with particle size and grading, coatings with shape and surface texture, and elastic properties. New material covers petrographic examination, thermal properties, and chemical reactions.

The fourth section, for convenience, is titled Other Materials and ranges from mixing and curing water to mineral admixtures. Here information on mixing and curing water, heretofore scattered, has been brought together for the first time in a concise presentation. Another paper, summarizing the large volume of information on curing materials which represents years of development, is a valuable addition.

In all, there are 39 papers in this publication, totaling nearly 400 pages. Copies can be obtained from ASTM Headquarters, 1916 Race St. Philadelphia, Pa. Price: $5.25; to members, $4.

Gillett Lecture—Powder Metallurgy

THE FOURTH Gillett Lecture, "Powder Metallurgy—Now (New Techniques, Improved Properties, Wider Use)" is by Fritz V. Lenal, Associate Professor, Department of Metallurgical Engineering, Rensselaer Polytechnic Inst.

Dr. Lenel, in discussing the comparatively recent development of powder fabrication shows its economic value when used in structural parts that do not bear structural loads. He points out that in many machine parts wrought steel is employed because it is relatively cheap and not because its mechanical properties are needed. Critical evaluation of strength, ductility, and toughness required will show whether a powder part may be used instead of a high-strength material.

The lecture describes the production of semifabricated products such as extrusions, forgings, sheet, rod, and wire from powder which have properties superior to those made by fusion metallurgy. These techniques have been particularly successful in light metals.

Especially current is Dr. Lenel's discussion of the contributions of powder metallurgy in the development of materials possessing high strength at elevated temperatures, sorely needed in jet engines and in the utilization of atomic energy. The thermal shock sensitivity of the cermets appears to have been remedied and the present principal research effort is bent on increasing their inherently low toughness.

The Gillett Lecture is sponsored annually by ASTM and Battelle Memorial Inst. and is presented at the ASTM Annual Meetings in honor of Horace W. Gillett, a leading metallurgist and first Director of Battelle.

The lecture will be published in the 1955 *Proceedings*. Reprints in special paper covers can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $1.50; to members, $1.15.

New X-Ray Diffraction Data in Demand

SECTION 6 of the X-Ray Diffraction Data Card File has recently been completed and published and is now available in Plain and Keysort cards, with a new edition of the 700-page Index book. Section 6 is composed of approximately 600 new powder patterns, and 600 corrections for cards in the previously issued Sections 1, 2, 3, 4, and 5, bringing the file well up to date.

This diffraction data file is sponsored by the American Society for Testing Materials, American Crystallographic Assn., British Institute of Physics, and National Assn. of Corrosion Engineers.

Beside the demand for this material by research laboratories, geological and research departments of universities, governmental and industrial laboratories in this country, this X-Ray Diffraction Data File is being used by many laboratories abroad, in England, France, Germany, Belgium, Switzerland, Japan, and South America.

Information regarding this file or Section 6 will be gladly furnished by communicating with ASTM Headquarters.

Erratum in Part 1, 1955 Book of ASTM Standards and Steel Piping Compilation

A TYPOGRAPHICAL ERROR of some consequence has occurred in the Tentative Specifications for Electric-Fusion-Welded Steel Pipe for High-Temperature Service (A 155-55 T) which appear on p. 78 of Part 1, 1955 Book of ASTM Standards, and on the same page of the 1955 compilation, "ASTM Specifications for Steel Piping Materials."

In Section 10 (Number of Tests) the definition of "lot" in the second sentence states that a lot may not consist of more than one heat of steel. This is an error and the word "not" should be deleted, so that the second sentence would correctly read:

A lot shall consist of all pipe of the same material (may include more than one heat of steel) and wall thickness which is heat treated in one furnace charge (Note).

Interesting Membership Data

Effects of Neutron Irradiation on Steel—A Timely Paper

A most interesting paper emanating from the Oak Ridge National Laboratory presents data on the effects of neutron irradiation on the ductility, strength, and mechanical test behavior of a group of austenitic stainless steels and several carbon steels. This paper which will appear in ASTM *Proceedings* was written by J. C. Wilson and R. G. Berggren, and is being made available at this time in preprint form.

From the results, the authors conclude that irradiation can alter the behavior of these metals to such an extent that existing material specifications may not be applicable to metals that will be subjected to neutron bombardment in service.

Mechanical test results were obtained for carbon and austenitic stainless steels that had been subjected to integrated fast neutron fluxes of 10^{19} to 10^{20} nvt. The results generally confirm data obtained by others; but certain peculiarities of behavior were observed during the testing program. The shape of the stress-strain curve for austenitic stainless steels is altered, and with sufficient irradiation, or a high enough testing speed, the metals showed definite yield points. In addition, the yield stress of the irradiated austentic stainless steels was found to depend strongly on the strain rate.

In carbon steels, irradiation sometimes eliminated the yield point and decreased the ductility to a greater extent than in austenitic stainless steels. Annealing of irradiation effects in carbon steels during irradiation at elevated temperatures was found to exert varying degrees of influence in different mechanical properties. Notch-bar impact tests on the carbon steels showed the effect of irradiation on the transition temperature.

There appears to be strong evidence that irradiation can cause structural metals to behave in a manner sufficiently different from unirradiated metals that a new concept of the relationships between mechanical test results and service performance must be formulated in evaluating metals for service in nuclear reactors.

It is now well established that neutron irradiation can alter the mechanical properties of metals. Conventional mechanical testing procedures provide numerical values for the changes of strength and ductility produced by neutron irradiation. But neutron bombardment of a metal can introduce changes in the structure that cannot be duplicated by alloying, heat treatment, or deformation; and the irradiated metal is therefore in a state or condition outside normal metallurgical experience. For this reason, the interpretation of mechanical test results obtained for irradiated metals is not clear, and it cannot be assumed that the existing relationships between results from standardized mechanical tests and service performance will be the same as for an unirradiated metal.

Copies of this 19 page reprint can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: 50 cents.

Compilations of ASTM Standards

Cement

Prepared by Committee C-1 on Cement, this publication, in its thirteenth edition contains all the ASTM standard specifications and test methods pertaining to cement in convenient form.

In addition to the standards, there are four appendices covering the Manual of Cement Testing; an extensive list of selected References on Portland Cement; Information on Analytical Balances and Weights; a paper on "The Principle of the Methoxyl Method for Determining Vinsol Resin in Portland Cement;" the By-laws and personnel of Committee C-1.

Copies of this 280-page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia Pa. Price: $2.75; to members, $2.

Plastics

This seventh edition provides in their latest approved form more than 100 of the ASTM standard specifications and test methods developed and sponsored by Committees D-20 on Plastics and D-9 on Electrical Insulating Materials. These standards are applicable to the raw materials of plastics and to the finished products made from them, such as molding compounds, sheets, tubes, rods, and molded or fabricated articles. They do not include certain electrical tests and materials covered by other ASTM committees.

Copies of this 770-page compilation can be obtained from ASTM Headquarters, 1916 Race St., Philadelphia, Pa. Price: $5.75; to members, $4.40.

Booth Displaying ASTM Books at the 1955 Annual Conference and Products Exhibit held by the National Institute of Governmental Purchasing, Hotel Shoreham, Washington, D. C., October 16-19.

This is the third consecutive year that ASTM has been invited to display its literature to officials responsible for purchasing millions of dollars worth of materials for various Government agencies at all levels, National, State, County, and Municipal. The NIGP is a nonprofit educational and technical organization of governmental buying agencies of the United States and Canada. It is organized to study, discuss and recommend improvements in governmental purchasing; to interchange ideas and experiences and obtain expert advice on local, state and national governmental purchasing problems; to collect and distribute to governmental purchasing officials information on the organization and administration of governmental buying; to develop and promote simplified standards and specifications for governmental buying; to promote uniform purchasing laws and procedures. NIGP Headquarters are in Washington, D. C.

Interesting Membership Data

(Designed to Bring Our Members Up to Date, to Thank Them, and to Look Ahead into 1956)

1955 Was a Banner Year

Over 750 New Members in 1955— 99 Transfers to Sustaining Class

THE YEAR has not closed, but it can be stated definitely that over 750 new members joined ASTM in 1955. This is a record high, and the Committee on Membership and Board of Directors are appreciative of the efforts of all who contributed toward this gainful end. But, of course, this must not be the end. Another year is almost upon us, and anticipating that it too may be a good year membershipwise, it is urged that everyone interested "keep on keeping on."

Always one of the main sources of new members is the current membership. The acquisition of new members through individual interest and committees has been an important factor in keeping membership growth healthy, and it is hoped that no one will relax his endeavors.

The Committee on Membership asks that each member of ASTM whenever feasible point out the advantages of membership to both individuals and companies who might be interested, and stress at the same time that new members can contribute to the Society's work.

Value of Membership

Factors contributing to the particular value of ASTM affiliation to an individual or company vary greatly in specific cases. One industry may find that the relations between producer and consumer concerning quality and testing are based almost entirely on ASTM standards. Another organization may find that the continuous receipt of data on the properties and tests of materials through the extensive ASTM publications is an equally valuable asset. The individual member, particularly if he serves on technical committees, may feel that his contacts alone justify affiliation.

From the standpoint of publications received, unquestionably the companies as well as the individual members do get for their dues a large number of valuable books. Despite the change in the mechanics of distributing the Year Book and *Proceedings* (that is, on request) the policy is one of liberality with respect to furnishing publications. Obviously, for the standards to be used, and for the technical papers and special symposiums to have the maximum value they must have widespread distribution.

The organization of new technical committees should be mentioned in any discussion of membership values. As discussed in various news articles, several new committees have been set up and others are in process. From each of these groups will come new authoritative information and data, new standardized test methods, and eventually specifications.

ASTM Sustaining Membership

Comment on the salutary aspects of the 1955 membership picture would not be complete without reference to the marked increase in the Sustaining Membership class. Ninety-nine Sustaining members have been enrolled within the past year.

The January, 1955 BULLETIN carried a listing of 61 companies transferring to Sustaining Membership. The accompanying list includes 35 additional companies authorizing such transfer, also three entirely new Sustaining Members.

The Sustaining group now embraces upwards of 360 company members who are taking advantage of the liberal publication privileges offered Sustaining Members. At the same time, through annual dues of $150, they are aiding substantially in underwriting the work of the Society which is vitally significant in the various industrial fields.

A note to Headquarters will bring detailed information on the publications received by Sustaining Members.

NEWEST SUSTAINING MEMBERS

Allen-Bradley Co.
Ansul Chemical Co.
Automatic Electric Co.
Bethlehem Pacific Coast Steel Co.
Cameron Iron Works, Inc.
Canadian Westinghouse Co., Ltd.
The Chesapeake & Ohio Railway Co.
Climax Molybdenum Co.
Cluett, Peabody & Co.
Coors Porcelain Co.
Cummins Engine Co.
De Laval Steam Turbine Co.
Detroit Testing Laboratory, Inc.
Wilbur B. Driver Co.
Dunlop Tire and Rubber Corp.
Duquesne Light Co.
Ebasco Services, Inc.
Erie Forge & Steel Corp.
Fels and Co.
H. K. Ferguson Co.
Fluor Corp.
Formica Co.
Feed Transformer Co.
General Aniline and Film Corp.
Giant Portland Cement Co.
Glens Falls Portland Cement Co.
Kollsman Instrument Corp.
Longhorn Portland Cement Co.
McDonnell Aircraft Corp.
Metal & Thermit Corp.
Mycalex Corporation of America
National Portland Cement Co.
Ohio Apex Div., Food Machinery & Chemical Corp.
Ohio Edison Co.
Peerless Cement Corp.
Plastics Metals Div., Natl. U. S. Radiator Corp.
Stromberg-Carlson Co.
Whitehall Cement Manufacturing Co.

(Several other companies are considering transfer in 1956.)

New Class of Associate Membership . . .
Current Members Urged to Help

THE DIRECTORS have instructed that an appropriate article dealing with the new class of Associate membership be used in this BULLETIN over my signature. Probably this is largely in recognition of the intensive interest of the Staff through the years in membership work. Certainly my various associates have given yeoman service in maintaining a healthy growth and stimulating a membership that is alive to the needs of industry and Government in our area and most important, helping to meet those needs.

Always our membership work has had the strong and stimulating support of the Directors' Membership Committee which three times a year reviews, appraises, and charts.

Our Aim—Younger Members

The new Associate Membership is designed to have a dual effect: first, to bring into the Society more young members (under 30 years of age); and, simultaneously, to stimulate more interest and activity on the part of the younger engineering faculty men.

The future growth of the Society (not growth simply for the sake of numbers, but to insure that our standards and research work shall be up to date and expanding) requires a continuing influx of interested, relatively younger men. As the Society grows older, we find relatively more of our skilled committee men retiring, or for various reasons (in many instances going on to administrative and executive work) relinquishing their committee work. Fortunately most of these men themselves help us to obtain adequate replacements. But our reserves need strengthening, and with the increasing demands on technical and engineering men we must secure an adequate over-all share of time for ASTM.

While a great many of our active members put ASTM as their primary society interest, it is recognized that most ASTM men also have a professional contact; and sometimes interest in materials is not stimulated until a man has been with his company for quite a few years.

The Directors felt we had too few "Junior" members; and that raising the age limitation from 27 to 30 years for the new "Associate" class, and dropping the "Junior" terminology would tend to encourage more men under 30 to join.

Benefits—Tangible and Intangible

A careful study of the Society's publications indicated that for the modest Associate dues of $10 we should furnish the ASTM BULLETIN, the Year Book, miscellaneous material such as the Index to Standards and preprinted papers and committee reports; and give an option of either a Part of the Book of Standards or the Annual *Proceedings*, with the privilege of securing the other respective book at the nominal annual charge of $3.

Now, all that membership means to a full member is a measure of the value of an Associate membership—the opportunity to follow important work and to get extremely valuable data on the properties and tests of materials (data that for the most part have been reviewed by a number of qualified experts and do not represent just one person's opinion). And we believe strongly that a man's value to his company or his Government department frequently can be enhanced by the better knowledge of materials. Our Directors to a man support this belief.

What of the young college instructor and faculty member? In a way this "Associate" membership should be equally or more advantageous to him because he has a tremendous responsibility to help inculcate in the future engineers in his classes the significance of the importance of materials. Our future engineers should have good strong training in materials technology. They need not necessarily be experts but certainly should know about newer materials and applications, and know where to obtain sound information. Obviously we recommend ASTM.

In short, we think the younger faculty people will not only be benefited themselves but their membership in ASTM will help them turn out well-rounded engineers.

The Membership Committee and the Staff have some ideas for publicizing this Associate membership class, but nothing we can do is nearly as constructive as the personal interest of a current member. So, as in many of these membership messages, we make a direct appeal to each ASTM member either to give us the names of younger men who might be approached, or to make the approach directly.

Naturally I am enthusiastic about the value of membership in the Society, the tremendous significance of what has been done and will continue to be done, and the unexcelled *esprit de corps* in the Society.

Finally—maybe Dr. Granville M. Read, Chief of the Engineering Department, E. I. du Pont de Nemours & Co., Inc., has expressed the basis for our concern better than all the above: recently he noted that discoveries and developments of new physical properties in materials had accelerated engineering progress but stressed the importance of "human materials." Quoting directly:

> Our human materials are the most important contour of any engineering profile. They are obviously the source of all technological gains. Only if we find the way to forge ahead, preserving and expanding the incentives to free inquiry and unshackling human energies, can we expect to win the treasure which the future holds in store.

R. J. PAINTER
Executive Secretary

P. S.

New Activities

Cellular Materials
Carbon Black
Materials for Nuclear Energy and the Effect on Materials of Exposure to Radiation
Electronic Materials
Titanium

You name them! When industry has a need for specifications and tests, or sound data on the properties of materials, we will supply it.

That "we" means 13,000 competent materials experts—presidents and vice-presidents (a surprising number), metallurgists, chief chemists, chemical engineers, mechanical, civil, electrical and aeronautical engineers, etc.—banded together, making up ASTM.

ACR Notes

Administrative Committee on Research

Unsolved Problems in Review

By A. T. McPherson[1]

Is it worthwhile to prepare lists of Unsolved Problems? Are the really important problems likely to be included? What proportion of the problems will be solved? To help in answering these and related questions a list of unsolved problems of a generation ago has been reviewed in the light of subsequent developments. This list was published in the Fortieth Anniversary issue of the *India Rubber Journal* on August 22, 1924, under the title "What We Do Not Know About Rubber." Eight world authorities in rubber science and technology collaborated in setting down 58 problems that they considered to be the major problems facing the industry. The list starts with the basic problems, "What is rubber?", and includes problems ranging from questions of structure and reaction mechanism to analytical methods and manufacturing operations.

The author, who read this list with much interest when it was published, has now reviewed it from the perspective of present day knowledge of rubber and finds that it foreshadowed many of the subsequent developments in science and technology. Many of the questions that were asked then have been answered in a way that exceeded any expectations.

The present report is based on general considerations rather than on a case-by-case study such as might be made by setting down each problem and relating it to the numerous individual publications bearing on the answer. Such a study would be a major research and would require the services of specialists in the different branches of rubber technology.

Also, no effort has been made to ascertain how many of the subsequent researches owed their inspiration to the publication of the list. However, the list was widely publicized and discussed at the time it appeared and undoubtedly affected the thinking and the selection of problems, even though it might be difficult to establish the connection between the list and specific research reports that were published subsequently.

Significance of the Problems

Looking backward, a very considerable number of the problems for which solution was sought in 1924 relate to matters that are regarded as basic today. This is particularly true of problems relating to the composition, properties, structure, and behavior of rubber. The mechanism of vulcanization and the role of accelerators are subjects on which many investigations have been made and research is still being done. A few of the problems are of less importance today than formerly because of changes in the industry. In 1924, for example, chemical analysis was widely used for the evaluation of rubber products, and a simple direct method of determining rubber hydrocarbon was in considerable demand and was listed as one of the unsolved problems. In 1942 a relatively simple and effective method for natural rubber was published in the ASTM Bulletin, but neither it nor any other method for the same purpose has yet found its way into general use in specifications because the present-day purchaser of rubber goods has little concern with rubber content, and also because natural and synthetic rubbers are often used in the same products by different manufacturers or by the same manufacturer at different times.

There is even less interest today in certain of the 1924 problems that relate to manufacturing processes. "Bloom" on rubber goods, for example, has ceased to be a problem because of radical changes in manufacturing processes.

By and large, however, the problems that were listed in 1924 were important as indicated by the fact that virtually all of them have been the subject of subsequent investigations, and some have been treated in hundreds of papers.

The major development that was not foreseen at that time was the development of synthetic rubber. The need for oil-resistant rubber had not been realized to the extent that anyone visualized the synthesis of polymers that were radically different from natural rubber in properties. Nor did any one foresee that the shutting off of the supply of natural rubber would force development of a general purpose synthetic.

Problems, Solved and Unsolved

Since the purpose in preparing lists of unsolved problems is to obtain answers to questions, it is pertinent to ask what percentage of the problems of the 1924 list have been solved. If we take the solving of a problem to mean the attainment of the objectives that were understood when the problem was posed, the majority of the problems can be written off as solved. However, few if any solutions can be taken as final because objectives change with the advance of knowledge. Consider, for example, the problem of the molecular weight of rubber. In 1924 a measurement showing that the average molecular weight was, say, about 500,000 would have constituted a satisfactory solution. In the intervening years many measurements have been made and work is still in progress because we now wish to determine weight-average and number-average molecular weights and also the range of molecular weights and the distribution of molecules in each part of the range.

The need for a clear statement of objectives is emphasized by considering some of the problems in the 1924 list for which no solution has been found. One such problem called for the development of a simple test-tube reaction to determine the quality of raw rubber. No solution has been found or even seriously sought because quality may relate to many things, ranging from tensile strength, plasticity, and rate of vulcanization to cleanliness, color, and uniformity. This problem doubtless had a specific meaning to the person who asked that it be listed, but failure to state the objectives kept it from being the subject of serious consideration by others.

The questions that were asked about rubber in 1924 undoubtedly had a part in stimulating research that has transformed rubber from a little-understood and supposedly unique vegetable material to a versatile product that can be made in a thousand different ways to serve a multitude of uses. This bit of experience from the past warrants confidence in the ASTM project on Unsolved Problems. With the continued focusing of attention on the frontiers of knowledge, another generation may witness even greater accomplishments than those of the past 30 years in rubber science and technology.

[1] Associate Director, National Bureau of Standards, Washington, D. C.; Member, ASTM Administrative Committee on Research.

Latest Approvals of ASTM Standards
October 17, 1955

Light Metals and Alloys, Cast and Wrought

Specifications for Aluminum Sheet and Plate for Pressure Vessels (B 178-55 T)

REVISED to add a section on basis of purchase; to revise chemical composition limits, mechanical properties limits, and dimensional tolerances to coincide with industry standards; to make minor editorial changes; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum and Aluminum-Alloy Sheet and Plate (B 209-55 T)

Revised to add a section on basis of purchase, to revise mechanical properties limits and dimensional tolerances to coincide with industry standards; to make minor editorial changes; to add alloy GR40A; to add five new tables of dimensional tolerances; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum-Alloy Drawn Seamless Tubes (B 210-55 T)

Revised to add a section on basis of purchase; to revise dimensional tolerances to coincide with industry standards; to make minor editorial changes, and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designation.

Aluminum and Aluminum-Alloy Bars, Rods, and Wire (B 211-55 T)

Revised to add a section on basis of purchase; to make minor editorial changes, and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, and Shapes (B 221-55 T)

Revised to add a section on basis of purchase; to make minor editorial changes; to revise dimensional tolerances to coincide with industry standards; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum-Alloy Drawn Seamless Tubes for Condensers and Heat Exchangers (B 234-55 T)

Revised to add a section on basis of purchase; to revise dimensional tolerances to coincide with industry standards; to make minor editorial changes; to add the T4 temper of Alloy GS11A and GS11C and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Aluminum-Alloy Extruded Tubes (B 235-55 T)

Revised to add a section on basis of purchase; to revise mechanical properties limits and dimensional tolerances to coincide with industry standards; to make minor editorial changes, and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum-Alloy Pipe (B 241-55 T)

Revised to add a section on basis of purchase; to revise mechanical properties limits; to make minor editorial changes; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum-Alloy Die Forgings (B 247-55 T)

Revised to include a section on basis of purchase; to make minor editorial changes; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum and Aluminum-Alloy Bars, Rods, and Shapes for Pressure Vessel Applications (B 273-55 T)

Revised to add a section on basis of purchase; to revise chemical composition limits and dimensional tolerances to coincide with industry standards; to make minor editorial changes; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Specifications for Aluminum and Aluminum-Alloy Pipe and Tube for Pressure Vessel Applications (B 274-55 T)

Revised to add a section on basis of purchase; to revise chemical composition limits, mechanical properties limits, and dimensional tolerances to coincide with industry standards; to make minor editorial changes; and to add an appendix containing an alloy designation conversion table of ASTM and Aluminum Assn. designations.

Symposium on Winter Concreting

AN IMPORTANT subject of international interest in the field of concrete—"Winter Concreting—Theory and Practice" will be the theme of a symposium to be held in Copenhagen, Denmark, February 13 to 18, 1956.

The first group of sessions will discuss *theoretical* questions in connection with definition of climatic conditions and then reproduction in the laboratory, influence of temperature on the hardening of concrete; and frost resistance of concrete at early ages.

The second group of sessions will include *practical* questions in respect to choice of materials, heat and insulation; and winter concreting on the job site-procedure and equipment.

The last two days will be devoted to visits to job sites around Copenhagen and possibly to southern Sweden.

The symposium is being held under the auspices of the International Association of Testing and Research Laboratories for Materials and Structures (RILEM) and sponsored locally by the Danish National Institute of Building Research.

Registration forms and information can be obtained by addressing communications to: RILEM Symposium 1956, c/o The Danish National Institute of Building Research, 20, Borgergade, Copenhagen K., Denmark.

ASTM Bulletin

DECEMBER 1955

NO. 210

NINETEEN-SIXTEEN
RACE STREET
PHILADELPHIA 3, PENNA.

ASTM in the Field of Nuclear Energy

THE DEMAND for standard materials employed in nuclear energy development, particularly in reactors, and the need for information on radiation effects on materials was explored at a conference on November 11, in New York, called by ASTM President C. H. Fellows, Detroit Edison Co. It was the unanimous sense of the meeting that the ASTM Directors be asked to alert the technical committees to consider immediately the need for standards in their areas and to determine whether sufficient data are available on which to base sound recommendations.

The conference advocated the prompt formation of a small group of experts with ASTM background to constitute a coordinating or advisory committee on the subject.

Present at the meeting were leading authorities in the fields of metals, rubber, plastics, water, and other materials, and representatives of users, operators, and other groups directly concerned. Every effort was made to have a representative group.

ASTM representatives, in addition to President Fellows, included Past-President N. L. Mochel, Westinghouse Electric Corp., who acted as technical chairman, and Messrs. F. L. LaQue, International Nickel Co., and A. Allan Bates, Portland Cement Assn., national ASTM Directors. A number of committee officers were present representing technical groups particularly concerned with nuclear energy such as A-10 on Iron-Chromium Alloys, E-10 on Radioactive Isotopes. Mr. F. C. Robinson, Chief, Reactor Development Branch, Atomic Energy Commission contributed in considerable measure to a better understanding of some of the problems. Many problems lie ahead in this work, but a feeling of optimism prevailed at the meeting, and a strong note that ASTM, as the leading Society concerned directly with the properties and tests of materials, should be responsible for developments in this field. Further details of the meeting will be given later and the actions of the Board of Directors will be reported.

OFFERS OF PAPERS FOR 1956

THE Administrative Committee on Papers and Publications will meet early in February to consider the papers to be published by the Society in 1956 and to develop the program for the Annual Meeting which will be held in Atlantic City, N. J., June 17 to 22.

All those who wish to offer papers for presentation at the meeting and publication by the Society should send these offers to Headquarters *not later than January 10, 1956*. Offer forms are also available to those interested in submitting papers for presentation at the September 1956 Pacific Coast meeting.

All offers should be accompanied by a summary which will make clear the intended scope of the paper and will indicate features of the work that will, in the author's opinion, justify its publication and inclusion in the Annual Meeting program.

Suitable blanks for use in transmitting this information will be sent promptly upon request to Headquarters.

Schedule of ASTM Meetings

This gives the latest information available at ASTM Headquarters. Direct mail notices of all district and committee meetings customarily distributed by the officers of the respective groups should be the final source of information on dates and location of meetings. This schedule does not attempt to list all meetings of smaller sections and subgroups.

DATE	GROUP	PLACE
Jan. 11	New York District Meeting	New York City
Jan. 12–13	Committee B-1 on Wires for Electrical Conductors	New York City (ASA Headquarters)
Jan. 23–25	Committee D-19 on Industrial Water	Biloxi, Miss. (White House)
Jan. 24	Joint Meeting St. Louis District and Missouri Society of Professional Engineers	St. Louis, Mo.
Jan. 25–26	Committee B-5 on Copper and Copper Alloys, Cast and Wrought	New York City (ASA Headquarters)
Jan. 30–Feb. 1	Committee A-1 on Steel	Pittsburgh, Pa. (Wm. Penn Hotel)
Feb. 5–10	Committee D-2 on Petroleum Products and Lubricants	Dallas, Texas (Statler-Hilton)
Feb. 10	Philadelphia District Meeting	University of Pennsylvania, Philadelphia, Pa.
Feb. 13–15	Committee D-9 on Electrical Insulating Materials	Philadelphia, Pa. (Ben. Franklin)
Feb. 15–17	Committee D-20 on Plastics	Philadelphia, Pa. (Ben. Franklin)
Feb. 17	Committee B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts	Pittsburgh, Pa.
Feb. 19–22	Joint Committee on Petroleum Wax	New York City (Commodore)
Feb. 27	Committee E-13 on Absorption Spectroscopy	Pittsburgh, Pa. (Wm. Penn Hotel)
March 13–16	Committee D-13 on Textile Materials	New York City (Warwick)
March 19–20	Committee D-12 on Soaps and Detergents	New York City (Park Sheraton)
April 11–12	Committee D-10 on Shipping Containers	Atlantic City, N. J. (Claridge)
April 12	Pittsburgh District Meeting	Pittsburgh, Pa.
April 25	Detroit District Meeting	Detroit, Mich.

1956 Nominating Committee

In accordance with the By-laws providing that the Board of Directors shall select a nominating committee for officers, the Board has considered the report of the tellers—N. H. Smith and J. A. Truitt—recommending members of the nominating committee, and has appointed the members shown below.

Serving on the 1956 Nominating Committee as *ex officio* members are the three immediate past presidents: H. L. Maxwell, L. C. Beard, Jr., and N. L. Mochel. The committee will meet in February and will nominate for the offices of president, vice president, and directors (5). The selections will be announced to the members in the ASTM Bulletin prior to transmission of the official ballots.

Members	Alternates
L. H. Winkler, Bethlehem Steel Co.	C. L. Kent, Jones and Laughlin Steel Corp.
C. M. Gambrill, Ethyl Corp.	S. S. Kurtz, Jr., Sun Oil Co.
C. H. Scholer, Kansas State College	Bryant Mather, Waterways Experiment Station
M. B. Niesley, California Testing Laboratories	E. O. Slater, Smith-Emery Co.
W. R. Willets, Titanium Pigment Corp.	E. R. Stivers, Package Research Lab.
A. C. Webber, E. I. du Pont de Nemours & Co., Inc.	Robert Burns, Materials Advisory Board, National Research Council

Interesting Talks at Standards Engineers Society Meeting

Representatives of engineering societies, the Department of Defense, and industry presented pertinent talks on subjects of interest to the Society in Hartford, Conn., September 29 to October 1. The sessions included a Symposium on "What Is the Future of Standards," "Organization of the Company Standards Program," "Standardization of Electrical Apparatus and Components," "Without Standards, No Automation," and "National Strength Related to Standardization." For the Symposium on "National Strength," the moderator was Roger E. Gay, Director of Cataloging, Standardization, and Inspection, U. S. Dept. of Defense. Others included Nathan Brodsky, Assistant Director, Colonel Joseph DeLuca, and Captain Charles R. Watts. Much progress is being made in coordinating Defense Department standards and at the same time, cognizance is being taken of the importance where possible, of coordinating industry and military requirements.

There is no lack of work to be done in the standards field—at least in the opinion of those participating in the Symposium on Future of Standards. Panel members consisted of the ASTM Executive Secretary, Robert J. Painter in addition to representative of The American Society of Mechanical Engineers, Society of Automotive Engineers, and the National Association of Purchasing Agents. Each of the speakers in the panel gave case histories of work under way or contemplated.

Richard S. Burke, Manager, Merchandise Testing and Development Laboratories, expressed much skepticism on the value of standards for ultimate consumer goods. It was felt that in certain cases such standards impede innovation and improvement of products.

Most of the papers presented at the meeting will be published in the *Proceedings* of the Standards Engineers Society. It may be possible to include abstracts of some of the items in a future issue of the ASTM Bulletin.

THE SOCIETY APPOINTS...

C. M. Harris to ASA Acoustical Standards Board

Leslie Silverman to ASA Sectional Committee Z74 on Fundamentals of Performance of Effluent Air and Gas Cleaning

I. L. Cooter to ASA Sectional Committees C 42 on Definitions of Electrical Terms and C 61 on Electrical and Magnetic Magnitudes and Units, succeeding R. L. Sanford

C. H. Hastings to ASA Sectional Committee Z54 on Industrial Use of X-Rays and Radiation, succeeding H. H. Lester

H. H. Zuidema and H. A. Ball to ASA Sectional Committee C 59 on Electrical Insulating Materials

K. M. Berg to ASA Sectional Committee A88 on Magnesium Oxychloride Cement Flooring

W. L. Fink to Joint Committee on Definitions of Terms Relating to Heat Treatment of Metals, succeeding O. W. Ellis

L. S. Reid and R. H. Carter to Joint ASTM-TAPPI Study Committee

K. G. Mackenzie (reappointed) to ASA Standards Council

J. E. Kinney and C. K. Rice to Inter-Society Committee on Uniformity of Methods for the Examination of Water, Sewage, and Industrial Waste Water

B. L. Lewis to Steering Committee of Joint ASTM-ALCA Committee on Leather

Mass Spectrometry Conference Sponsored by Committee E-14

The Fourth Conference on Mass Spectrometry under the sponsorship of ASTM Committee E-14 will be held at the Netherland Plaza Hotel in Cincinnati, Ohio, during the week of May 27, 1956. It is expected that a large attendance and active participation will make this Conference another successful one.

Papers are invited on all aspects of mass spectrometry. Those interested are invited to submit abstracts of their papers by February 15, 1956, to the Chairman of the Subcommittee on Programs and Papers,

William Priestley, Jr.
Esso Research & Engineering Co.
Box 121, Linden, N. J.

In accordance with the stated policy of the committee, authors will be free to publish in the journals of their choice.

Further information may be obtained by writing to:

Arthur B. Kent, Secretary
ASTM Committee E-14 on Mass Spectrometry
Sun Oil Co., Marcus Hook, Pa.

ASTM BULLETIN on Microfilm

The Society has entered an agreement with University Microfilms, Ann Arbor, Mich., for microfilming the ASTM Bulletin.

University Microfilms sells microfilmed copies of periodicals directly to purchasers. In the case of the Bulletin, sales will be limited to members of the Society and Bulletin subscribers. The microfilming will be done at the end of each calendar year.

Canada's NRC—A Correction

In the October 1955 Bulletin, pages 25-26, we described the fine work of the NRC and the contributions of individual staff members of NRC in serving as members of ASTM Committees. We erred, however, as to the actual number of individual ASTM members among the NRC staff.

The Canadian NRC maintains a Sustaining Membership in the Society and there are, in addition, two individual ASTM members from the NRC staff. Serving on 27 ASTM committees are 26 NRC staff men 24 of whom serve under the Sustaining Membership.

District Activities

Five Districts Hear Lenel, Gillett Lecturer

CHICAGO—ST LOUIS—SOUTHWEST—SOUTHERN CALIFORNIA—NORTHERN CALIFORNIA

Fritz V. Lenel, 1955 Gillett Memorial lecturer and Professor of Metallurgical Engineering, Rensselaer Polytechnic Inst., made a "grand tour" during October and early November through the West and Southwest speaking on his Gillett Lecture subject of powder metallurgy before five of the Society's Districts.

At the Chicago District on October 12, discussion was so extensive that it finally had to be cut off by the program chairman.

The following evening Dr. Lenel spoke before a joint meeting of the ASTM St. Louis District, the St. Louis Chapter of the American Society for Metals, and the Engineers Club of St. Louis. More than 125 were in attendance at the meeting and once again the animated discussion had to be stopped by President Giles of the Engineers Club.

Although not strictly an ASTM District meeting, Dr. Lenel was invited to speak before the ASM North Texas Chapter's "Southwest Metals Exhibition" which was held in Dallas the afternoon of November 3. A special invitation was extended to the ASTM Southwest District members, and more than sixty attended the afternoon session which included Dr. Lenel's talk. At a dinner-meeting the same evening Eric Jonsson, President, Texas Instrument Co., gave a general talk on the advancement of science.

The peak attendance for any of these meetings was attained when more than 200 members and guests of the ASTM Southern California District and ASM Los Angeles Chapter attended a dinner meeting in Los Angeles on October 27. Dr. Lenel's trip to the West Coast was in part sponsored by Kwikset Locks and Harvey Machine Co., and Adolph Schoepe, President of Kwikset Locks, and Herbert Harvey, Vice-President, Harvey Machine Co., were both present to welcome the speaker. Also in attendance was Past President of the Society, W. M. Barr.

Moving on to Northern California on the 28th, Dr. Lenel was the guest speaker of the ASTM Northern California District and the San Francisco Section of The American Society of Mechanical Engineers. Here again interest was extremely high as it was at

The ASTM Southern California District and the Los Angeles Chapter of the American Society for Metals met jointly in Los Angeles to hear Professor Fritz V. Lenel speak on powder metallurgy. Singled out of the large audience were local officers shown in these two photographs. Top, left to right: Dr. Lenel, P. J. Rich, Harvey Machine Co., who is also chairman of the Technical Program Committee for the September 1956 ASTM West Coast Meeting; and Jack Dickason, vice chairman, ASM Chapter. Below, left to right, ASTM Past President and Honorary Member William M. Barr; Roy E. Paine, chairman of the Local ASTM Chapter; and Myron B. Niesley, chairman of the ASTM Southern California District.

all the other meetings at which Dr. Lenel spoke.

Dr. Lenel, who was born in Kiel, Germany, received his Ph.D from the University of Heidelberg, and since coming to this country in 1933 has engaged in research and development work in the field of powder metallurgy. He presented at these meetings only portions of his Gillett Memorial lecture the complete version of which is now available (see p. 8).

Part of the ASTM and ASME groups which assembled in San Francisco to hear ASTM Gillett Lecturer, Fritz V. Lenel.

PITTSBURGH

COOPERATING with one of the more recently formed technical societies, the Standards Engineering Society, the ASTM Pittsburgh District and the SES Tri-State Section sponsored a joint meeting on October 27 on the general subject of "Aluminum in the Electrical Industry." The technical session, which followed a well-attended dinner, was divided evenly between Joel Tomkins and E. J. Holcombe, both affiliated with the Aluminum Company of America. Mr. Tomkins was transferred to Pittsburgh about a year ago from Alcoa's Massena Plant as a Senior Staff Engineer in the Electrical Engineering Dept. In his talk, "Research and Development of Electrical Conductors of Aluminum," Mr. Tomkins described interesting phases of Alcoa's recent research and development work.

E. J. Holcombe, also transferred from the Massena Plant, is now Staff Metallurgist in the Quality Standards Dept. in the Pittsburgh Office. Mr. Holcombe, in his address, "Development of Specifications in the Aluminum Conductor Field," covered the past, present, and future of electrical conductors and components.

One of the features of this meeting was the presentation of student membership prize awards sponsored by the Pittsburgh District Council. This is the first year for such awards in this area. At the present time, six awards are sponsored, but this number may be increased in future years.

The local group was surprised to find after the meeting was over, that our President, Claire H. Fellows, had attended the meeting incognito.

OHIO VALLEY

SPEAKING on the subject, "Research in the Electric Power Field," ASTM President Claire H. Fellows addressed a joint session on November 17 of the ASTM Ohio Valley District and the Cincinnati Section of the American Institute of Electrical Engineers. The address followed a dinner at the Hotel Netherland Plaza in Cincinnati. Attending the dinner and technical session were members of the two sponsoring groups, together with members of ASTM Committee D-9 on Electrical Insulating Materials which was meeting at that time in Cincinnati.

J. C. Pitzer, chairman of the Ohio Valley District, introduced President Fellows, who is Director of the Engineering Laboratory of Detroit Edison. In his address, the ASTM President outlined in exciting detail, the phenomenal growth of the power industry and the projected growth in the next decade. The research currently in progress to provide support for the orderly growth of the industry was described with the aid of excellent color slides. Also covered were the latest developments in the power field: high-voltage aluminum cable and extra-high-voltage cable; wood preservation—poles, crossarms, etc.; corrosion—especially galvanized steel transmission towers; tree growth control; fish fences; insulating oils; fundamental research aspects of hydrocarbons; and nuclear power.

NEW ENGLAND

ELECTRONICS held the limelight at the ASTM New England District's fall meeting on October 27. Three well-known figures in the electronics field participated in the program entitled "The Electronics Industry Contributes Some New Ideas." This is probably the most rapidly growing industry in New England, and, as the local district learned, the history of electronics and its applications is a fascinating one.

The three speakers, all employed by Raytheon Mfg. Co., each offered a separate and distinct approach.

Ralph Mondano, Head of the Plastics Research Laboratory of the Research Division, in his talk, "Plastics and Metals for the Electronics Industry," discussed some of the applications of high-strength, high-temperature-resistant plastics. He accompanied his talk with a demonstration of foaming of resins and the resistance of silicon foam to heat.

Leo Cronin, Head of the Techniques Dept., covered the properties, testing methods, and applications of recent developments in the field of technical ceramics. His paper, "Newer Ceramics in the Electronics Industry," emphasized application for cutting tools, jigs, coatings, cermets, and cathodes, etc.

When it was announced that a "full size demonstration" of the uses of microwave heating would be included in David A. Copson's presentation of "Microwave Heating," the audience did not realize that Dr. Copson was going to cook a 24-lb roast, (in 18 min) a lobster (in 3½ min), and bacon (in 9 sec). In connection with this he showed how energy at a frequency of 2450 megacycles is transmitted through such materials as glass without appreciable absorption, is reflected from metal surfaces, but is absorbed by foodstuffs and converted into heat energy which performs the operation of cooking.

Conference on Fatigue in Aircraft Structures

AN International Conference on Fatigue in Aircraft Structures will be held at Columbia University, January 30 to February 1, 1956.

Participating in the sessions on Physical Theories of Fatigue; Prediction of Fatigue Life and Fatigue Strength (Fatigue Testing); and Prevention of Fatigue Failure will be men from Europe, Australia, and the United States.

Detailed information can be obtained from A. M. Freudenthal, 1716 Engineering, Columbia University, New York City.

Technical Committee Notes

Cement and Concrete

Committees Hold First Meetings in Canada

THE FIRST meetings of Committees C-1 on Cement and C-9 on Concrete and Concrete Aggregates held outside the limits of the United States, proved to be very successful as indicated by a registration of over 150 members, visitors and wives. Montreal, with its interesting mixture of French and English cultures provided an attractive location for the October meetings of the two committees, which were arranged as a result of an invitation of the Canada Cement Company, Ltd.

A full week of committee meetings was scheduled, Wednesday being set aside for tours of Montreal and the Laurentian Mountains. At an interesting technical program held Tuesday evening, two illustrated talks were presented: the development of the St. Lawrence Seaways was described by Carl West, the principal official of the St. Lawrence Seaways Authority; Niagara Falls and the Ontario Hydro was discussed by Gordon Mitchell, Project Manager of the recently completed Sir Adam Beck Niagara Generating Station No. 2. A third talk by John Narsted, Vice-President of Canada Cement Co., Ltd, reviewed the development of the cement industry in Canada and in particular the great expansion of his company. E. G. Swenson, National Research Council of Canada, presided at the session and introduced Dr. Leon Lortie, Pro-Mayor of the City of Montreal and Director of Extension Courses, University of Montreal, who brought the message of welcome on behalf of the city of Montreal, and Mayor Jean Drapeau.

Numerous Revisions Before Cement Group

A NUMBER of subcommittees presented reports at the meeting of Committee C-1 on Tuesday, October 4. The Sponsoring Committee on Portland Cement reported an interesting discussion on the significance of fineness in relation to the effect on bleeding and strength of portland-cement concrete.

Revisions increasing compressive strength requirements in the Tentative Specification for Portland Blast-Furnace Slag Cement (C 205), at 3, 7, and 28 days were presented by the Sponsoring Committee on Blended Cement and approved by the committee. The deletion of limits on TDA and 109-D, as part of the chemical requirements in this specification, was also approved.

The Sponsoring Committee on Masonry Cement is continuing its cooperative study of the water retention test in an effort to make it more usable and reproducible.

In the reports of the working committees, several revisions were proposed and accepted. A change in the Tentative Method of Test for False Set (C 359) was approved, relating to the use of a brass weight and a change in the mixing time for the penetration tests. Further surveys are needed to establish sufficient information on the use of this test method and correlation with field surveys before limits can be recommended for specification purposes.

Consideration will be given by the Subcommittee on Coordination of Tests to an additional source of standard sand for use in cement testing.

The use of the mechanical mixer for making briquets, and methods for increasing the uniformity of 2-in. cubes, is being considered by the Subcommittee on Strength. The uniformity of test batches is also included in the work of this subcommittee. Further refinements of the Tentative Methods of Test for Bleeding (C 243) are contemplated and recommended revisions will be presented before the next meeting of the committee.

A performance test for the potential sulfate resistance in portland cement was accepted for publication in the ASTM BULLETIN as information only. This method is intended for determining potential sulfate resistance of portland cement by measuring the expansion of mortar bars containing excess calcium sulfate.

The Subcommittee on Volume Change reported agreement to recommend to Committee C-1 at its next meeting, the withdrawal of the Standard Method of Test for Soundness of Hydraulic Cement over Boiling Water (Pat Test)(C 189). It is the feeling of the subcommittee that this method is no longer of general use, having been replaced by the autoclave test.

The Subcommittee on Chemical Analysis announced that portland cement check samples were now available at the Portland Cement Assn. (at a cost of $2 per sample) for three types of portland cement. Standard samples of portland cement are also available at the National Bureau of Standards at a cost of $4.25 per sample.

The Subcommittee on Cement Reference Laboratory reported that 18 laboratories had been recently inspected, 8 of which were in Canada. Inspection has shown that the motor-driven flow tables give good performance.

The talk customarily presented at each meeting of the main committee consisted on this occasion of a history of the work of the Sponsoring Committee on Blended Cement, given by L. R. Forbrich. The hydraulic property relationship and the hydraulic modulus were illustrated with the use of slides.

Special recognition was given to two prominent members of the committee: P. J. Freeman, a member of the Society and of the committee since 1923, and now retired, was elected to honorary membership. This was the last meeting in which John R. Dwyer acted in an official capacity as Technical Assistant and as Head of the Cement Reference Laboratory. J. R. Dise, a member of the Cement Reference Laboratory for a number of years, was officially announced as successor to the position of Technical Assistant of Committee C-1 and as Head of the Cement Reference Laboratory. Mr. Dwyer is expected to continue on the consulting basis for a period of time.

Several Standards Overhauled by Concrete Committee

A FULL schedule of meetings involving 18 subcommittees and the main C-9 committee were held on October 6 and 7. Several actions on standards were taken subject to confirmation by letter ballot. A complete revision of the Method of Test for Air Content of Freshly Mixed Concrete by the Pressure Method (C 231) was accepted, embodying the determination of the air content of freshly mixed concrete from observations of the change in

volume with a change in pressure. Revisions in the Standard Specifications of Concrete Aggregate (C 33) will modify the requirements relating to aggregates that may be reactive with the alkalies in cement.

A complete revision of the Method of Test for Organic Impurities in Sands for Concrete (C 40), representing several years of study by the subcommittee, was approved, providing among other changes, for the use of a colored glass reference standard. This subcommittee also obtained approval on the revision of the soundness test of aggregates (C 88), involving the insertion of a definition of "a piece of aggregate." Nine revisions to the four methods of testing concrete for resistance to freezing and thawing (C 290, C 291, C 292, and C 310) involve further refinement in the test procedures.

Several standards and revisions of standards are now ready for subcommittee letter ballot and for presentation to the committee at its next meeting. These include revisions of the tentative specifications for lightweight aggregate (C 330, C 331, and C 332) covering packaging. The proposed specification for packaged, dry, combined materials for mortar and concrete, published as information in the April 1955 issue of the ASTM BULLETIN, was reviewed in subcommittee and changes made on the basis of comments received. This specification will now be circulated to the subcommittee for initial acceptance preparatory to submittal to Committee C-9 for recommendation as a new ASTM tentative specification.

There is considerable activity in the Subcommittee on Testing Concrete for Strength, which is expected to lead to numerous revisions for clarifying the various methods of testing concrete for strength.

Two alternate methods of testing concrete for setting rate are being prepared in draft form for circulation. A proposed method of test for natural pozzolan in material as admixtures is approaching completion.

The Subcommittee on Volume Change of Concrete and Concrete Aggregates is preparing for publication as information a discussion on various methods of testing aggregates for volume. The Manual of Concrete Testing is expected to be in draft form by March 1956.

Work in the recently organized Subcommittee on Pore Structure of Aggregates has reached the point where a cooperative study of a series of aggregates will be made, representing a wide range of pore characteristics. In the study of the evaluation of data, an effort is being made to define more clearly what constitutes a test of concrete for compressive strength.

Chemical-Resistant Mortars

Two Groups of Subcommittees Set Up in Committee Reorganization

A GENERAL reorganization of Committee C-3 has been effected, and the first meeting under the new arrangement of subcommittees was held at ASTM Headquarters on October 31. The main business was to review the new organizational features and establish membership and the plan of operation.

There will be two general groups of subcommittees: an "S" or Specifications Group, consisting of Subcommittees S-1 on Silicate Mortars, S-2 on Resin Mortars, S-3 on Sulfur Mortars, and S-4 on Hydraulic Mortars; and a "T" or Test Methods Group, consisting of Subcommittees T-1 on Mechanical Properties, T-2 on Physical Properties, T-3 on Chemical Properties, and T-4 on Recommended Practice and Identification. In addition there will be an Advisory and an Editorial Subcommittee.

The test procedures to determine apparent porosity and absorption recently prepared will be verified by further confirming tests. Existing ASTM methods for compressive strength (C 306) and for tensile strength (C 307) of resin-type chemical-resistant mortars will be reviewed for the purpose of incorporating these methods by reference in specifications for silicate mortars.

The Subcommittee on Resin Mortars will turn over to the Subcommittee on Physical Properties three different procedures for determining coefficient of expansion for study and possible recommendation for reference in a specification for resin mortars. A method for determining chemical resistance of resin mortars is also needed. Round-robin tests will be conducted to develop methods for determining coefficient of thermal expansion and the porosity and absorption of chemical-resistant mortars. The application of the existing bond strength method to silicate mortars will be established by the Subcommittee on Mechanical Properties.

The new Subcommittee on Recommended Practice and Identification will review the needs for standard recommended practices in connection with the use of chemical-resistant mortars and their application.

Refractories

Manual on Refractories in Preparation

THE committee announced that three industrial surveys on refractory materials are completed and will be incorporated in the new Manual on Refractories which is expected to be published during the summer of 1956. These surveys are on coke-oven refractories in soaking pits for steel ingots, and refractories utilized in reheating furnaces. An industrial survey on refractories for annealing furnaces is in process.

Nine laboratories have been cooperating to establish a procedure of analysis of lithium, sodium, and potassium in refractories by the flame photometer. This method will be submitted to committee letter ballot in the near future.

Consideration was given to the revision of the scope of the Method of Test for Disintegration of Fireclay Refractories in an Atmosphere of Carbon Monoxide (C 288) to include unfired refractories such as plastic and carbon refractories and castables.

A revision of the Specification for Alumina-Silica-Base Castable Refractories for Boiler Furnaces and Incinerators (C 213) has been proposed and is now under consideration by the subcommittee. This revision is dependent upon the drafting of a classification for castable refractories. This proposed revision of the Classification of Fireclay Refractory Brick (C 27) is being submitted to committee letter ballot. Tests to be incorporated within a classification of silica brick are in progress in cooperating laboratories.

Methods for determining the oxidation rate and the rate of alkali attack of refractories are in process of completion.

Concrete Pipe

Trend to Larger Diameter Pipe Requires Review of Specifications

ONE is impressed at a meeting of Committee C-13 with the many factors involved in the requirements for good quality concrete pipe and the exact science which is becoming more and more necessary in present-day design of the larger size pipe. The committee met for two days in Chicago, Ill., on November 7 and 8. There was a very good attendance of both producer and nonproducer members, from all parts of the country, including the West Coast. In the trend toward larger diameter pipe, with corresponding higher requirements in design, the

committee has recognized the need for complete review of existing standard specifications. An important step in this direction will be the study of a comprehensive report dealing with the engineering design of reinforced-concrete pipe, which is being prepared by a technical committee of the industry. It is expected that the study will include large-size pipe up to a 5000-D loading.

For the first time the committee functioned under its new set of committee regulations, which provide for an organization consisting of an Advisory Subcommittee; standing subcommittees for complete specifications; and subcommittees on special problems, subject to discharge upon completion of assignment. Five standing subcommittees were established: I on Non-Reinforced Sewer Pipe (C 14), C. A. Bluedorn, chairman; II on Reinforced Sewer and Culvert Pipe (C 75 and C 76), C. M. Adams, chairman; III on Irrigation and Drain Pipe (C 118), P. W. Manson, chairman; IV on Low-Head Pressure Pipe (C 361), H. G. Curtis, chairman; and V on Low-Head Internal Pressure Sewer Pipe (C 362), J. A. Dunn, chairman.

One special problems subcommittee was organized on the subject of absorption tests, with J. W. Johnson as chairmen.

A considerable number of items on the agenda pertained to comments and suggestions for the revision of the six existing standard specifications for concrete pipe. In most cases these matters were referred to the proper subcommittee for more detailed consideration.

Action was taken on certain items for letter ballot of the entire committee in order that they may be presented as recommendations to the Society in the 1956 Annual Report. There has been a difference of opinion on the proposed replacement of the hydrostatic test with a permeability or fill test procedure. In an attempt to reconcile the differences, the committee took action to adopt as standard the present tentative revision of the Standard Specification for Non-Reinforced Sewer Pipe (C 14), with further revisions. The result of this action, if approved by letter ballot of the committee, will prescribe the fill test as the standard requirement with provision that the hydrostatic test shall be used where required by the purchaser. A revision in the appropriate section of the four specifications for concrete pipe (C 14, C 75, C 76, and C 118) was approved for immediate adoption, providing more definite control of the temperature range in the ventilated oven used in connection with the absorption test.

Another revision accepted for immediate adoption and applying to these same four specifications involves a change in the wording of the sub-paragraph defining the rejection of pipe on the basis of the absence of distinct web-like markings. This change will provide for the waiving of this requirement if specimens submitted for tests have passed the physical test requirements of the specification.

The committee approved a recommendation of the Advisory Subcommittee requesting the Board of Directors of the Society for jurisdiction over concrete drain tile specifications. Such action, if granted, would involve the separation of the existing Standard Specification for Drain Tile (C 4). Assurance would be given to the Board of Directors that suitable representation would be provided on the committee of both producer and nonproducer interests.

Thermal Insulating Materials

Committee Inspects Effect of Moisture Research Program

A FRUITFUL meeting of Committee C-16 was held on October 24–26 at the Nittany Lion Inn, University Park, Pa. The location of the meeting at Pennsylvania State University provided an opportunity for members to inspect the research program sponsored by the committee on the effect of moisture on thermal insulating properties. At a special evening session, Prof. F. A. Joy outlined the results of the test program to date. There was also opportunity for committee members to visit the special research installations at the university, including the nuclear reactor facility and water tunnel.

The new Subcommittee on Reflective Insulation attempted to clarify its scope of operation and initial projects, one of which will be the preparation of definitions of housing, industrial, and refrigeration types of reflective insulation. Corrosion, considered to be an important factor in performance of reflective insulation, will be given attention.

An additional method for the measurement of water-vapor transmission which can be used with thick samples was approved for subcommittee letter ballot; results of the ballot will determine whether the method will be promulgated as a new tentative or published for information only. This method is the outcome of joint research by Armstrong Cork Co. and Pennsylvania State University.

It was agreed that sampling techniques are important in the testing of thermal insulating materials. A three-phase sampling plan was agreed upon, a draft of which will be circulated to the Subcommittee on Dimensional Standards for review. Handleability has been discussed on previous occasions by the committee and the need for further study was re-emphasized.

In the measurement of thermal conductivity, the subcommittee concerned will review the present guarded hot plate method (C 177) giving consideration to a thin plate method. A reference bibliography on apparatus for determining thermal conductivity was reported to be partially completed, and copies have already been circulated to the subcommittee. It was the consensus that the art of using the heat flow meter is not sufficiently advanced to warrant consideration for incorporating it into an ASTM method. An additional method, involving the Wilkes calorimeter, will be circulated for subcommittee review.

Two new tentative specifications were reviewed, prior to submittal to subcommittee letter ballot or comment: a specification for mineral wool felt insulation (industrial type) for elevated temperature up to 600 F; and a specification for batt or blanket type thermal insulation for buildings. A revised final draft of an emissivity test method will be submitted for subcommittee letter ballot.

A new Subcommittee on Definitions and Nomenclature was authorized with K. M. Ritchie, Baldwin-Hill Co., as chairman. A special subcommittee was appointed to supervise the preparation of a compilation of standards on thermal insulating materials for publication by the Society in 1956.

Acoustical Materials

Methods of Measurement of Sound Impedance Near Completion

THE MEASUREMENT of sound impedance and absorption of acoustical materials continues to be a major activity in Committee C-20 as reported at its fall meeting held in Chicago, Ill., on October 19. It is expected that the determination of this basic property will soon be covered by ASTM tentative methods. Comparative studies of tests using the reverberation-room method now show no appreciable difference and a draft of the test method procedure is being prepared for consideration at the next meeting.

The proposed method of test using the impedance tube apparatus is now in the final stages of preparation for committee ballot. Sources of apparatus meeting the requirements of the test

have been established. Reports on a third method for measuring sound absorption, namely, the box method, are being secured from three places where this apparatus is now being used.

The subcommittee concerned with fire resistance properties, in addition to sponsoring some cooperative work on a modified form of the panel test described in the Federal Specification SS-A-118b, is closely following the development of other types of apparatus in the field of flame-spread tests. General agreement was reported on results of the modified panel test procedure, between the Riverbank Laboratory and the National Bureau of Standards, and a third draft of a proposed method is being prepared. Reports on the status of the small tunnel test research program at Forest Products Laboratory indicated that further tests are being conducted in an effort to establish a closer check with the results of the large tunnel test used by the Underwriters' Laboratories. The radiant panel apparatus—a relative newcomer in the field of fire tests—will be closely observed by the subcommittee to establish its potentialities. An interesting report on flame spread tests being conducted by the National Research Council of Canada was presented. In these tests, complications are being eliminated by not attempting to compare the test results with other flame-spread test methods, but rather to establish a relationship with actual burn-out tests.

Problems relating to washability and soiling of acoustical materials are being actively pursued. The washability test involving the action of a brush on the surface of acoustical tile has been circulated to committee members. Comments received indicated that this type of action was too severe and did not represent a service condition. Further consideration of the cleaning of acoustical tile will be tabled until a current project at the National Bureau of Standards, sponsored by the Public Buildings Service, is completed. A second project at the National Bureau of Standards on the soiling of acoustical materials is also under way. The three possible causes of soiling were described, namely, impingement, breathing or air leakage, and thermal precipitation. The two basic questions which need to be resolved are, (1), can materials be cleaned, and (2), if not, what is the best method of painting acoustical materials.

The Subcommittee on Application has been developing a specification for adhesives for applying acoustical tile. One problem remaining is development of a suitable aging test. Good progress was reported on an acceptable aging test method as a result of cooperative tests at three laboratories, using six kinds of adhesives, most of which have had successful commercial usage. It is expected that both a visual and a penetration type of test will be used. Rate of change of plasticity is the factor to be determined. Development of standards for mechanical suspension systems will receive more attention after work has been concluded on the adhesive aging test. Tests are expected to be conducted not only on the materials involved but eventually on the entire suspension system.

Following the recent publication by the Society of the Tentative Method of Test for Strength Properties of Prefabricated Architectural Acoustical Materials (C 367), attention is being given to a flow resistance method and the Baumgartner sphere. The flow resistance method will be initially published as information only in the ASTM BULLETIN. The Baumgartner sphere method is being tested in several laboratories under the sponsorship of a committee of the Technical Association of the Pulp and Paper Industry and is proving to be satisfactory for measuring light reflectance of acoustical materials.

Ceramic Whiteware and Similar Products

Ferrites to Be Studied

FERRITES will now be included in the group of materials for which standard methods are being developed, as a result of action taken at the meeting of Committee C-21. The committee met in Bedford Springs, Pa., on September 29, in conjunction with the fall meeting of the Whitewares Division of the American Ceramic Society. The new section on ferrites will be formed under the Subcommittee on Tests and Specifications. Committee A-6 on Magnetic Properties, also concerned with ferrites, will be invited to participate or furnish liaison.

A new section is being organized under the chairmanship of T. S. Shevlin, Engineering Experiment Station, Ohio State University, to develop standards in the field of cermets. This group will be concerned initially with the development of a suitable definition of the term "cermet" and will prepare a scope based on a coverage of physical tests of ceramic materials used in cermets. It was recognized that cermets are of direct interest to other ASTM committees such as, Committee B-9 on Metal Powders and Metal Powder Products and the Joint Committee on Effect of Temperature on the Properties of Metals.

Reports on development of standards for both raw materials and products were presented. The group on titanates and zirconates is now considering tests on barium titanate in which a special firing technique is required. A later meeting of this group is planned after certain meetings on dielectrics are held at Rutgers University.

Proposed methods for thermal conductivity and for compressive strength of fired whiteware materials have been reviewed and are ready for presentation to the Society. Proposed methods for evaluation of the translucency of fired whiteware specimens and for determining crazing are not yet ready for committee ballot.

The Subcommittee on Nomenclature reported four meetings had been held during the year; 58 terms have been accepted as standard by the Society, and 29 additional terms have been accepted as tentative.

Shipping Containers

Reproducibility in Drop, Vibration, and Drum Tests Studied

THE WORKING groups of Committee D-10, meeting in New York City on October 21 and 22, reviewed the collaborative testing programs completed in the past six months and made recommendations as to the further course of the extensive studies necessary to revise the drop, vibration, and drum tests to achieve greater reproducibility. Results of the latest collaborative work on the stacking test have pointed toward a modification of the proposed test to increase the stacking load to 80 per cent of the static compressive strength of the container and to limit the duration of the test to 30 days.

Revised drawings for the 7-ft revolving hexagonal drum tester have been approved and will shortly be made available for distribution.

An interlaboratory collaborative test program reviewing the Methods of Test for Water Vapor Permeability of Shipping Containers (D 1008) was reported, and the variations of the results were studied so as to set up a more definitive program this winter.

Several Task Groups are working on various phases of interior packing. Projects under study include static and dynamic testing of cushioning materials, tests for general physical and chemical properties of interior packing materials, and a revision of the Package Cushioning Bibliography.

Electrical Insulating Materials

Corona, Insulating Oil Papers Accent Lively Technical Sessions

IMMEDIATELY following and partly concurrent with the meeting of Committee D-20 on Plastics was the fall meeting of Committee D-9 at the Netherland Plaza Hotel in Cincinnati, November 16–18. At the previous meeting, the committee had expressed an interest in standards for magnet wire. This had been the subject of a questionnaire and on the basis of interest shown, together with discussions with representatives of the National Electrical Manufacturers Assn. (NEMA) and of Sectional Committee C-9 on Magnet Wire it was decided that the D-9 activity for the present would be limited to development of test methods with particular emphasis on the use of magnet wire as a means of testing insulating varnishes. ASTM representation on Sectional Committee C-9 will be increased so as to provide better liaison and coordination of activities.

Much of the activity in the technical sessions was concerned with preparation for the forthcoming meeting of Technical Committee 15 of the International Electrotechnical Commission to be held in Munich, Germany, in June, 1956. Dr. A. H. Scott, chairman of Committee D-9, is also technical adviser to IEC TC-15, (the leader of U. S. representation) and many of the American representatives on the working groups are members of Committee D-9. The committee has been active in evaluation of a number of proposed international standards submitted by other countries. In some cases counter-proposals to certain of the methods will be presented by the U. S. representation at the next meeting.

During the business session of Committee D-9 there were several recommendations for committee ballot. These included a revision of Methods of Testing Pasted Mica Used in Electrical Insulation (D 352). Also to be included in the next committee ballot is a proposed specification for general-purpose grade glass polyester sheet laminate. This proposed specification was previously balloted in the committee and the new ballot will represent a revision to resolve negative votes. It was voted to submit to committee ballot a revision of Methods of Testing Silicone Insulating Varnishes (D 1346).

Dielectric Strength of Insulating Oil—Round Table

In the evening following the first day's sessions, the very active insulating oil group held a round-table discussion at which papers were presented by H. S. Endicott and E. R. Thomas. Mr. Endicott, of General Electric Co., spoke on Electrode Area Effect and Its Extremal Basis for the Electric Breakdown of Transformer Oils. This paper will be presented in full at a forthcoming meeting of the American Institute of Electrical Engineers.

Earl Thomas, Consolidated Edison Co., outlined some recent studies on electrode shapes, making reference to recent literature on the subject. An interesting feature of his presentation was the showing of a motion picture of dielectric breakdown of oil in a test cell.

Symposium on Corona

The Symposium on Corona under the chairmanship of C. W. Ross, James G. Biddle Co., was held on Thursday evening. Two groups of papers were included on the program under the headings of Corona Resistance and Corona Measurements. Papers and authors are as follows:

Corona Resistance:

Preliminary Corona Resistance Test Results from IEC Activities—C. W. Ross, James G. Biddle Co.

Measurement of Corona Resistance of Various Materials—R. D. McClain and E. Macura, Westinghouse Electric Corp.

Effects of Corona on Thermosetting Plastic Laminates—A. Rufolo & R. R. Winans, Naval Material Lab.

Corona Resistance Test Method for Laminates, Molded and Cast Materials—W. T. Starr, General Electric Co.

Corona Measurements:

Preliminary Investigation of Proposed Pulse Method for Measuring Ionization—F. S. Oliver, T. A. Pinkham, E. H. Povey, Doble Engineering Co.

Corona Detection and Measurement at Sixty Cycles—J. R. Nye, General Electric Co.

Test Methods for Measuring Energy in a Gas Discharge—S. I. Reynolds, General Electric Co.

A lively discussion followed each group of papers and the symposium lasted far into the night. There is a great need in the electrical industry for standard test methods for evaluating the corona resistance of materials. This is particularly true as operating voltages are raised and requirements for insulating materials become more stringent. This symposium will provide a base line for standardization of corona testing, and publication of the papers should also provide permanent contributions to the literature on this subject. Plans for publication of these papers are going forward.

Textile Materials

Committee Hears Hamburger's Marburg Lecture

COMMITTEE D-13 held a four-day meeting in New York City, October 18–21, with an attendance of over 200 members and guests. There were meetings of thirty-five task groups on the first two days, followed by meetings of twenty subcommittees.

The meeting was highlighted by the presentation by Dr. Walter J. Hamburger, Director of Fabric Research Laboratories, Inc., of the 1955 Marburg Lecture, which he had given previously to the Society at the Annual Meeting in June. The title of the lecture was "A Technology for the Analyses, Design and Use of Textile Structures as Engineering Materials." The lecture brought up to date the developments that have taken place in the use of textile fibers as engineering materials since the Marburg Lecture delivered by Dr. Harold DeWitt Smith in 1944.

At the meeting of Subcommittee A-1 on Cotton Fibers, a very interesting paper on "The Cotton Shippers' Viewpoint on Scientific Test Methods and Standards," was presented by Otto Goedecke, President, Otto Goedecke Co., Hallettsville, Tex. Mr. Goedecke stressed the need for quality control, and suggested that any serious consideration of quality control should encompass the entire growth cycle of the cotton fiber, beginning in the field and carrying through to the finished fabric. He likewise advocated improved and new methods of testing.

The subcommittee on cotton has under way a cooperative test program to evaluate the Shirley Analyzer. A new method of test for strength of cotton at finite gage length has been prepared and will be submitted to committee vote for publication as information. Methods of test for determining fiber length and number of neps are under study by task groups. In preparation is an Operator's Manual which, it is believed, will be very helpful to the laboratory technician in carrying out the various test methods for cotton fibers.

Subcommittee A-4 on Asbestos Textiles has appointed a task group to prepare specifications for industrial asbestos tape. The committee has under study a heat-aging test for asbestos tape and is reviewing the Method for Magnetic Rating of Asbestos Used for Electrical Purposes (D 1118).

The committee on wool fibers has active task groups studying the following: (1) neps, slubs, etc., in wool slivers and top, (2) extractable matter in wool, (3)

tensile strength of wool fiber bundles, (4) moisture determination in wool fiber and top, (5) fiber length of wool, (6) vegetable matter in scoured wool, (7) evenness, (8) average fiber, and (9) fineness.

The Subcommittee on Warp Knit Fabrics is making a study of bursting strength tests, using the ball burst and the Mullen testers. A definition of the term "warp knit" was completed and sent to committee letter ballot. Task groups are actively studying: (1) dimensional changes in laundering, (2) yield and related properties, and (3) grading.

The new Subcommittee B-1 on Performance and Chemical Tests, at its organization meeting, reported completion of procedures for analyzing mixtures of Dacron and wool, and methods for quantitative analysis of mixtures containing Dynel. It received a report from a task group on cooperative tests in three laboratories on methods for the analysis of Dacron-Cotton and Dacron-Viscose blends. The Standard Method for Identification of Fibers in Textiles (D 276) has been under study for the past two years. Proposed revisions in these methods were received for committee letter ballot.

The new Subcommittee B-7 on Test Methods for Fibers reported completion of proposed methods of test for linear density of textile fibers by the vibroscope which is being published as information and has under study methods for determining crimp of textile fibers.

The newly organized subcommittee on Fabric Test Methods will circulate a questionnaire to determine the degree of interest in undertaking work on test methods for wash-wear characteristics. The cooperative laboratory abrasion test for shirt fabrics is expected to be completed within the coming year. The test for recovery of textile fabrics from creasing, using the vertical strip apparatus (Monsanto Machine) is being studied as regards the weight to be used in the test. Weights of several different sizes are being studied in a series of cooperative tests. Studies are being made of tests for restorability and tension pressure of knit goods.

New tentative methods of tests for stiffness of textile fabrics (D 1388 – 55 T) have just been completed. These cover the Cantilever Method (preferred) and the Heart Loop Test (alternative). A proposed falling pendulum tear test (Elmendorf Tester) will be subjected to cooperative tests. Other tear tests are also being considered by another task group. Basic characteristics of various machines are being investigated in six laboratories using eight test fabrics. It is hoped, by means of this study, to determine what the problems are in tear testing, what machines are suitable for such tests, and the best features of each.

Among those assembled at the Textile Committee luncheon to hear W. J. Hamburger's Marburg Lecture, were, front row, left to right: B. L. Whittier, North Carolina State College; ASTM Vice-President R. T. Kropf, Belding Heminway Co., Inc.; D-13 Chairman, W. D. Appel, National Bureau of Standards; Dr. Hamburger, Fabric Research Laboratories; W. H. Whitcomb, Secretary of D-13; K. L. Hertel, University of Tennessee; Back row, left to right: P. J. Smith, ASTM Staff; H. A. Ehrman, D-13 Secretary; G. H. Hotte, Allied Chemical and Dye Corp.; G. E. Hopkins, Rayon and Acetate Fiber Producers Group; J. S. Jacobs, Textile Research Inst., Inc.; D-13 Vice-Chairman C. W. Dorn, J. C. Penney Co., Inc.; M. H. Gurley, Jr., Duplan Corp.

The Subcommittee on Ultimate Consumer Textile Products has undertaken an extensive investigation of seam construction. Representatives of the sewing machine manufacturers and of the sewing thread companies are participating in this work.

Subcommittee B-6 for ISO/TC 38 on Textiles reviewed the progress that had been made in preparing methods for determining (1) the linear density of yarns, (2) breaking load and breaking elongation of yarns, and (3) twist in yarns. It is anticipated that the work will be completed before the end of the year. This work is the responsibility of Subcommittee B-6 acting for the ASTM since the secretariat of ISO/TC 38 Subcommittee 5 on Yarn Tests is held by the USA.

Plans have been formulated to submit for active consideration by the ISO the methods for testing cotton fibers adopted by the ASTM with possible allocation of the secretariat of a special subcommittee on cotton fiber testing to the United States.

The chairman reported that plans are being made for a plenary session of ISO/TC 38 to be held in England, May 14 to 18, immediately before the Annual Conference of the British Textile Inst. While the formal agenda has not been set up, it is anticipated that the delegates will discuss fiber, yarn, and fabric tests, definitions, commercial regains, analysis of fiber mixtures, conditioning and other topics. The establishment of new subcommittees on (1) labeling with respect to washability, and (2) water repellency of air permeable fabrics, will be considered. (Colorfastness tests and shrinkage tests will be discussed in New York in September, 1956.) It is hoped to have a strong delegation of American textile scientists attend the meeting in England.

The Subcommittee on Pile Floor Coverings, continuing its study of flammability tests, is planning further work to determine factors which are contributing to inconsistent results two of which may be moisture content and sample aging. Additional samples of fabrics have been obtained for further study of these and other factors under more exacting conditions. It is hoped that a method for the measurement of flame propagation may be completed by the spring meeting of the committee. Active work is also under way on the development of test methods for tufted pile floor coverings. These include studies of colorfastness tests, soiling tests, and rubber backing tests. The committee is also reviewing the Standard Methods of Testing Pile Floor Covering (D 418) to determine which of the methods are satisfactory for application to the testing of tufted carpet.

The subcommittee also discussed methods for the service evaluation of pile floor coverings. A task group appointed on this project plans to meet prior to the spring meeting. The committee reported that a proposed revision of the Test for Colorfastness to Light, covered in Sections 18 to 22 of Methods of Testing Pile Floor Covering (D 418) has been approved by letter ballot.

Adhesives

Current Research Papers Presented at Meeting

HIGHLIGHTING the Committee D-14 meeting in Cleveland, Ohio, October 27–28, was the presentation by three committee members of current research topics. This portion of the program is a regular event and serves to inform the committee members of interesting research in the adhesives field.

The first subject considered was tack or contact adhesion, its measurement and parameters, which have been discussed within the committee for many years. Although it is a critical property of adhesives, much work remains to be done due to the difficulty of establishing fundamental test methods for its measurement. F. Wetzel, discussing some of his recent work pointed out that this work led him to believe that two different mechanisms, wetting of the adhesive and fluidity or viscosity, were essential for tack as against pressure-sensitive adhesives in which there was possibly no viscous or plastic flow. Wetzel also pointed out that parameters of tack such as wetting might be measured as heat of immersion by the use of a calorimeter; free surface energy by the peel strength; energy of activation by measurement of temperature coefficients; and modulus of elasticity by standard apparatus.

Mrs. H. R. Merriman described recent research work on the influence of polymer orientation at interfaces on joint strength. Dilute solutions of adhesives were applied in multiple brushings to encourage preferred orientation of the molecules to the metal adherent. These solutions were permitted to dry slowly and upon subsequent test were found to be significantly superior to adhesive bonds prepared in the normal manner.

N. J. DeLollis discussed some preliminary work on the adhesion of polyethylene to metals. He pointed out some of the interesting results and the influence of polarity on adhesion.

New Standards Ready

Actions, taken at the meeting, approved the submittal to full committee letter ballot of the Tentative Method of Test for Effect of Bacterial Contamination on Permanence of Adhesive Preparations and Adhesive Bonds (D 1174) for adoption as standard; Tentative Recommended Practice for Determining the Effect of Moisture and Temperature on Adhesive Bonds (D 1151) for adoption as standard with revisions; proposed method of test for amylaceous matter in adhesive to be published as tentative; and consideration of adhesive definitions for penetration, thinner, and adhesiveness as tentative.

Actions approved for submittal to subcommittee letter ballot included the proposed method of test for nonvolatile content of urea-formaldehyde resin solutions, with revisions; proposed tentative method of test for peel resistance of adhesives (climbing drum peel-tester) and the proposed method of testing the peel strength of adhesives (aero method); proposed specification for room-temperature and intermediate-temperature setting adhesives; proposed method of test for nonvolatile content of aqueous adhesives.

Standards in preparation include a recommended practice for conducting creep testing of metal-to-metal adhesives; a proposed method of test for hydrogen ion concentration of dry adhesive films; proposed specifications for room-temperature and intermediate-temperature setting adhesives; and a proposed specification for adhesives for high-speed automatic machine labeling of glass bottles.

Engine Antifreezes

Rubber Immersion Test Group Reports

AT THE meeting of Committee D-15, held in New York on October 22, the Study Group on Rubber Immersion Test of Subcommittee V, presented the Fourth Collaborative Test Program Report of the Rubber Immersion Test for Engine Antifreezes. This 85-page report is the culmination of 4-years work on the effects of antifreeze solutions on rubber compounds. The collaborative test program has involved the participation of twelve laboratories testing 15 coolants and three types of rubber. Like the Tentative Procedure for Glassware Corrosion Test of Metals by Engine Antifreezes (D 1384) recently issued, the rubber immersion test is a glassware screening test and will be followed by a more definitive mechanical bench type test.

The Study Group on the Glassware Foaming Test of Subcommittee VI is initiating a series of collaborative tests among eight laboratories using three antifreezes with a variety of foaming characteristics.

The Study Group on Simulated Service Test Methods of Subcommittee II is reinitiating work on a simulated circulation bench test with five laboratories cooperating.

Method of Test for Water in Concentrated Engine Antifreezes by the Iodine Reagent Method (D 1123) was discussed

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in the light of new approaches to the use of the Karl Fischer reagent. Since borates and other alkalies used as inhibitors in antifreezes interfere with the reagent, reliable results cannot be expected. A study is being initiated to determine a possible modification of the method to take into account this interference.

A revised draft of the Specification for Hydrometer-Thermometer Field Tester for Engine Antifreezes (D 1124) will be submitted following completion of a collaborative test on a dilution series of antifreezes.

Plastics

Break All Records for Attendance at Plastics Committee Meeting

With a total registration of 147, Committee D-20 established an all-time record for attendance at its meetings. The committee met November 14–16 at the Netherland Plaza in Cincinnati.

The growing interest in the activities of the several new subcommittees concerned with reinforced plastics, plastic pipe, etc., has given rise to an increasing need for cross-representation with other committees of the Society. With reinforced plastics being used increasingly in building, the committee appointed A. G. H. Dietz as representative and C. H. Adams as alternate to ASTM Committee E-6 on Methods of Testing Building Constructions. The Plastics Committee, also concerned with flammability of plastics, approved the appointment of W. J. Sauber as a representative on Committee E-5 on Fire Tests of Materials and Construction.

Several items were recommended for letter ballot of the committee. A proposed new flammability test for plastics based on the SPI method will be balloted upon as well as a revision of the Method of Test for Flammability of Plastics over 0.050 in. in Thickness (D 635). The committee approved for ballot two items having to do with permanence; one was a recommended practice for outdoor weathering and the other was the revision of Method of Test for Resistance of Plastics to Chemical Reagents (D 543). The very active group on nomenclature and definitions will submit to committee ballot a number of definitions of terms to be added to Definitions of Terms Relating to Plastics (D 883). A proposed specification for styrene-acrylonitrile molding and extrusion material was approved for committee ballot.

There has been a ferment of activity in the reinforced plastics and plastic pipe subcommittees, and by the time of the spring meeting it is expected that a number of proposed test methods and specifications will be ready to submit for ballot of the committee.

Impact Studies Described at Research Session

A well-attended session of the Research Subcommittee on Tuesday evening, November 15, featured four papers, two of which were concerned with impact testing.

Ross H. Supnick Monsanto Chemical Co., in his paper on modulus density relationship pointed out that the ASTM tension test for plastic films gives a stress-strain curve with no straight-line portion, and the error in modulus determinations by this test can be considerable. Data were presented which related the density of polyethylene at various times after molding to the modulus. He explained that density is related to crystallinity which is also related to modulus. In the data presented, it was shown that there is a straight-line relationship between the 5 per cent secant modulus and the density. He pointed out that with a linear relationship between two properties, it is not necessary to make both determinations.

C. C. Bragaw, E. I. du Pont de Nemours & Co., Inc., described a modification of the izod impact machine and specimen design which enabled the determination of tensile impact properties. Data were presented to show the effect of molded and machined notches on the impact tensile strength of several different thermoplastic materials. Good correlation of the tensile impact test with certain drop tests was noted. It was further noted that a tensile impact and ordinary izod impact do not rate a variety of materials in the same order.

George Jackson and C. H. Adams, Monsanto Chemical Co., in their paper on notch radius variations showed that very small radii in the notch gave low strengths for a variety of materials. As the notch radius was increased, a considerable spread in impact strengths of different plastic materials was observed, with cellulose acetate butyrate highest, vinyls and styrene-rubber combinations following in that order.

S. D. Toner, and F. W. Reinhart, National Bureau of Standards, in their paper on determination of resin content presented data to show that when calcium carbonate is used as a filler, ignition of the specimen causes weight loss attributed both to the resin binder and to carbon dioxide from the calcium carbonate. They explained how the error from calcium carbonate decomposition could be eliminated or at least accounted for by recombining the carbon dioxide, using ammonium carbonate as a reagent

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Materials for Electron Tubes and Semiconductor Devices

New Committee off to a Good Start

AN UNDERCURRENT of excitement pervaded the first full-scale meeting of the committee in Washington November 3 and 4 following its organization at the Annual Meeting of the Society in June. Committee F-1 counted 105 members attending the Washington meeting, this figure contrasting with the 65 members of the former subcommittee VIII of Committee B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts which formed the nucleus of Committee F-1. The two new activities—semiconductors and luminescent materials—account to a major degree for the awakened interest and quickened activities of Committee F-1.

Because of the rather extensive interrelationships among various organizations concerned with electronics, invitations have been extended for liaison representation with The Institute of Radio Engineers, American Institute of Electrical Engineers, Society of Motion Picture and Television Engineers, and Radio-Electronics-Television Manufacturers Assn. In contrast with the interest of many groups concerned with standardization in the electronics field, Committee F-1 is concerned with the basic materials which go into devices and not the devices themselves nor with the circuitry which occupies the attention of many other groups.

A new revision of the Methods of Testing Sleeves and Tubing for Radio Tube Cathodes (F 128) was approved for letter ballot of the committee. The fact that these methods had previously been revised this year is indicative of the pace at which improvements and innovations are made in the electronics field. Also approved for committee ballot, was a revision of the Specification for Molybdenum Wire under 20 mils in Diameter (F 289).

Analytical groups, both those concerned with spectrographic and wet chemical methods, have been active in developing suitable methods of analysis of electron-tube materials. These groups will now extend their efforts toward solving some of the analytical problems in semiconductors and luminescent materials. Analytical problems with electronic materials are often entirely new and without precedent. Spectrographic methods are often considered the ultimate in sensitivity, and yet there is evidence that in electronic materials work, the presence of certain elements undetected by the usual spectrographic methods will have an appreciable effect on the electronic properties of the materials. Also, the effects of what might be called sub-trace quantities of impurities in chemical reagents used in electronics work are so great as to make it necessary in some cases to set aside a batch of a reagent with which to run a standardized test.

Committee activity on metallic-nonmetallic seals was begun at this meeting with a show of hands of those interested and a luncheon get-together.

The problems before the semiconductor group, though many and difficult, were tackled energetically and excellent progress toward a program of projects was made. Initial efforts will be directed toward standardization of test methods for germanium oxide and germanium metal. The committee will confine its activities principally to the development of electrical tests, and will call on Committees B-2 on Non-Ferrous Metals and Alloys, E-2 on Emission Spectroscopy, and E-3 on Chemical Analysis of Metals for assistance in the development of other tests.

The luminescent-materials problems are similar in many respects to those on semiconductors and include determination of such properties as bulk density and particle size. Also a number of analytical problems similar to those on semiconductors apply. Some of the problems peculiar to luminescent materials which will be vigorously pursued include development of a standard demountable tube and methods for determining wet and dry adherence, light output and efficiency, color and color uniformity, emission spectra, and analysis for major and minor elements.

Reliability of Vacuum Tubes Discussed at Dinner Session

The committee was fortunate to have as an afterdinner speaker on the evening of November 3, Ray Knight of Aeronautical Research Inc., who spoke on the subject "Reliability of Vacuum Tubes." Mr. Knight's talk was based on results of a long-term contract with the military services held by his company with the general objective of discovering the factors which influence the reliability of vacuum tubes. It was revealed that while there is a relationship between reliability and properties of the base materials which go into the tubes, certain operational factors are even more important. One of the most important factors found to shorten the life of vacuum tubes was excessively high heater voltages which occur under some operational conditions.

Lehigh University Dedicates Engineering Laboratory

THE GREATLY enlarged Fritz Engineering Laboratories at Lehigh University were dedicated with interesting and impressive ceremonies on Friday, October 14. Among the highlights were demonstrations of the new 5,000,000-lb testing machine for testing compression and flexure, and large dynamic testing equipment.

An 8-in. steel bar was pulled in tension, requiring about 2,500,000 lb in tension to fracture, and in compression a 25-in. square laminated temper column required about 3,500,000 lb before failure. The machine, built by Baldwin-Lima-Hamilton Corp., reaches about 60 ft above the test floor and about 16 ft into the foundation pit.

The dynamic equipment, produced by Amsler, can take very large specimens and apply loads up to 100 tons at rates of 250 to 500 cycles per minute.

The new Fritz Laboratory Buildings consist of a seven-story section 130 by 70 ft and a four-story section 114 by 24 ft.

At the dedication the chief address was by Dr. Allen V. Astin, Director of the National Bureau of Standards, who stressed the importance of adequate testing facilities and the benefits to be derived both from the research data that result and instruction of the students. These new facilities have been made possible through the cooperation of the Bethlehem Steel Co.

Present at the meeting were many leaders in the field of materials testing and research. In addition to the representatives of the Baldwin organization including Frank G. Tatnall, Manager of Testing and Research, there were representatives of other testing machine and construction companies, including Alfred J. Amsler. The Amsler Co. has been a member of ASTM since 1920. Executive Secretary R. J. Painter represented ASTM.

These new facilities emphasized the constantly growing interest in determining properties of materials and assemblies.

The most productive arrangement INTERNATIONAL STANDARDIZATION ORGANIZATION

Assistance offered ASTM committees as a result of

Improved Measurement Methods for Appearance Attributes

By George W. Ingle[1] and Richard S. Hunter[2]

THE APPEARANCE properties of materials dealt with by Committee E-12 on Appearance differ from most properties studied by ASTM because they depend upon the response of the average human being. Appearance properties are "psychophysical"—that is, they are measured by physical techniques especially designed to yield numbers correlating with ratings by human observers. Because of the lack of a completely objective basis and the associated difficulties in devising effective specifications and test methods, need for these has persisted for some years.

Measurements of appearance factors have for years been used in controlling and standardizing the production of consumer materials. Now, with the current emphasis on styling plus the unending pressure for upgrading quality in all product lines, appearance factors are receiving even more attention. This situation raises a problem for ASTM. The creation of Committee E-12 in 1947 was in direct response to this need for recognition and solution of problems dealing with appearance attributes. Since then, consolidated methods of measuring optical properties pertinent to a broad spectrum of materials have been standardized. In addition, several symposia were held, frequently jointly with associated organizations and always presenting broad, expert, and sometimes divergent views of typical problems. What now appears needed, after these eight years of organization, development, and handling of individual problems is an improved understanding of how Committee E-12 and the technical committees for the various materials can best coordinate for effective recognition and solution of such problems.

To better understand this problem it is helpful to ask: "What is meant by appearance attributes?" These are factors in appearance dependent on certain physical properties most frequently measured by techniques which divide into two classes:

1. Those associated with color arising from spectral selectivity in reflection or transmission of light, and
2. Those such as gloss, haze, transparency, turbidity, texture, etc., arising from geometric selectivity.

Measurement of these several factors has focused attention on the relative advantages of the trained human eye and properly designed instruments. The eye is remarkably agile and sensitive, with high resolution in comparing the appearances of similar materials. It can make extremely rapid comparisons, leading to a single judgment integrated from a complex variety of attributes. Furthermore, the trained eye is—at first glance at least—not related to initial dollar cost, nor to costs for repair and preventive maintenance which are inherent in any instrument.

Why, then, is instrumentation for measurement desired? For one advantage, instruments can be designed to analyze numerically many of the factors contributing to the over-all impression gained by the eye. These component factors are frequently related to formulation or conditions of manufacture and, therefore, by their adjustment, a sensible program for reliable control of over-all product quality can be planned. Part of the important detail provided by instrumentation is the quantitative record, a prerequisite for sound analysis, control, and prediction. In some areas, such as for small color difference, for example, it must be recognized that the present state of instrumentation is such that the very best instruments, used with painstaking care, are only roughly equal to the most skillful observers. In other fields, such as gloss and transparency, instruments generally exceed the eye in precision and accuracy, except where the resolution of reflected or transmitted images is involved in visual judgments of appearance. This distinction points up a powerful advantage for instrumentation for measuring appearance factors—its reliability, resolution, and applicability is constantly improving. Not only is this progress accelerated by new developments in all fields of science, but its advance is pushed by intense competition for the instrumentation market itself.

In the experience of E-12 personnel in solving problems of appearance instrumentation, the proper steps to follow in selecting or developing a method for measuring an appearance attribute have been found to be these:

1. Select specimens exhibiting the property to be measured.
2. Have these rated visually by technologists *experienced with the material or materials in question.*
3. Have the same specimens studied in a photometric laboratory for differences in spectral and geometric selectivity.
4. Select from a comparison of instrumental measurements and visual gradings the photometric procedure which appears to yield best numerical correlation with the visual gradings.

The definite advances gained by this approach have been largely technical in nature. Now, there is strong support for the belief that further progress, through ASTM, requires simultaneous *administrative* growth. What is needed is recognition by personnel in the materials committees that (1) certain of their problems involve appearance factors, (2) while reliable methods of measurement for these factors may not have existed a decade ago, such are now available or in advanced stages of development, and (3) coordinated effort with personnel of Committee E-12 may provide solutions now or in the near future.

It is unrealistic to expect that Committee E-12 can solve these problems independently. In many cases, acquaintance with problems, particularly those specific to one material, is meager, if existent at all. Frequently, the problems are sufficiently large in scope and importance that they are best attacked by a group of smaller task forces, requiring a total manpower far exceeding that in Committee E-12 at present, or to be expected in the future.

[1] Research Section Leader, Monsanto Chemical Co., Plastics Div., Springfield, Mass.; Vice Chairman, Committee E-12 on Appearance.

[2] Hunter Associates Laboratory, Fall Church, Va.; Secretary, Committee E-12 on Appearance.

The most productive arrangement would seem to include:

1. Definition and presentation of the problem to Committee E-12 by the materials committee involved,
2. Technical review of the problem by E-12 personnel, particularly the physicists, but also others with specialization in the techniques of photometric measurements, optical psychophysics, as well as functional color utilization,
3. Preparation of a proposal by Committee E-12 for further work, if such is required, and for organization of the effort by recruiting one or more task forces from personnel of the materials committee interested in the problem, as well as from Committee E-12 itself.

In setting up these task forces, the limited membership of Committee E-12 is most effectively employed by offering technical guidance in devising methods for measuring appearance attributes, when the basic optical properties can be identified. To do this, it is necessary that the technologists representing the mat ials committee provide specimens and experienced judgments defining the properties in question. Organization of this sort should be highly productive of solutions to problems. Publication of final reports would be sufficient evidence of accomplishment and suggestion to others with remaining unsolved problems.

Linn Honored by Petroleum Committee

At its July, 1955, meeting, ASTM Committee D-2 on Petroleum Products and Lubricants honored its long-active member, Frank C. Linn with the following resolution:

Whereas, F. C. Linn, a charter member of Technical Committee C on Turbine Oils, has played a major role in its work, and

Whereas, he has served as chairman of Technical Committee C since its founding, giving valuable guidance and leadership, and

Whereas, through his efforts, knowledge of test methods and of the properties of turbine oils has been furthered, and

Whereas, he has served with equal distinction on Committee D-2 and its Advisory Committee,

Therefore, Be It Resolved this first day of July, 1955, that Committee D-2 formally recognize the contributions of F. C. Linn by communicating this resolution to him and to the members of Technical Committee C.

INTERNATIONAL STANDARDIZATION ORGANIZATION

Copper and Cast Iron Groups Hold First Meetings

ISO 26 on Copper and Copper Alloys

The first meeting of ISO 26 on Copper and Copper Alloys for which the United States holds the secretariat through American Standards Assn. was held June 13 and 14 in Stockholm, Sweden. The American delegation consisted of Walter D. France, Scovill Manufacturing Co., and Vincent P. Weaver, The American Brass Co. Mr. France is vice-chairman of ASTM Committee B-5 on Copper and Copper Alloys and Mr. Weaver has acted as secretary of Committee B-5 since 1944. The Executive Subcommittee of Committee B-5 advises the American Standards Assn. in this activity.

The attendance totaled 50, representing 18 member countries. Delegates were present from 11 of the 13 participating-member countries—Belgium, Czechoslovakia, Finland, France, Germany, Netherlands, Sweden, Switzerland, United Kingdom, United States, Yugoslavia—and from 7 of the 15 observer-member countries—Brazil, Hungary, Israel, Japan, Norway, Spain, U.S.S.R.

C. A. Jacobson, managing director, A. B. Svenska Metallverken, Vasteras, Sweden, and first vice-president of the Swedish Organization for Metal Standards, welcomed the delegates and pointed out that with the increased productivity of industry, standardization is needed in order to avoid the unnecessary specialization that increases costs. Folke Nilsson, director, Boliden Mining Co., Skelleftehamn, Sweden, acted as chairman and Mr. Weaver as secretary. Arrangements for meeting space and stenography were handled by the Swedish Organization for Metal Standards.

The committee adopted as the scope of its activities "nomenclature, specifications, sampling, and methods of test relating to material and products of copper and copper alloys; that is, alloys in which copper is the principal element." The committee ruled that the scope does not include material for particular purposes such as chemical products and metallic pigments, that it does not include products falling within the scope of other technical committees of the ISO and IEC (such as ISO 5, Pipes and Fittings; IEC 20, Electrical Cables; and IEC 12-5, High Frequency Cables), and, specifically, that there should be collaboration with ISO 5 on international standards for copper and copper-alloy pipe and tube.

Four study topics consisting of four ASTM Standards had been proposed by the secretariat for consideration and as a result, three of these were modified slightly and adopted as Draft Recommendations to be circulated to member countries for comment. These three include Classification of Coppers, Method of Test for Expansion of Copper and Copper-Alloy Tubing (Pin Test), and Method of Test for Residual (Internal) Stresses in Copper or Copper-Base Alloy Products (Mercurous Nitrate Test).

For future activity, a working group was set up to devote further study to a classification of cast copper-base alloys; a second group will study classification and properties of wrought copper and copper alloys; and a third, mechanical testing, basing its work on that which has been done in ISO 17 on Steel.

It was the general opinion that this initial meeting of the committee had made outstanding progress. Language seemed to present no great barrier, especially because of excellent interpreter service and the familiarity of some of the delegates with both English and French.

All of the deliberations in the plenary sessions as well as the group discussions were of a most cordial nature and there seemed to be present the best kind of group thinking and friendly cooperation. It was evident from the attendance, the attitude of the delegates, and the active interest at this first meeting, that international standardization in the field of copper and copper alloys is needed and should prove fruitful.

On the day following the two-day technical meeting, about 30 of the delegates visited the Vasteras Works of AB Svenska Metallverken to observe copper and brass mill operations. With other ISO delegates, planned trips were made to the Island of Lillsved in the Archipelago and to Drottningholm Palace and the Palace Theatre.

ISO 25 on Cast Iron

The first meeting of Technical Committee 25 on Cast Iron was held September 28 to 30, 1955, at the British Standards Inst., London, England. The Secretariat is held by the United Kingdom and the chairman of the meeting was J. G. Pearce, Director of the British Cast Iron Research Assn.

The thirty delegates from ten countries—Belgium, Czechoslovakia, France,

Germany, Italy, Netherlands, Sweden, Switzerland, United Kingdom, and the United States were welcomed by Mr. Binney, Director of the British Standards Inst. Mr. Henry St. Leger, General Secretary, ISO, also attended the meeting and assisted in matters of procedure.

The USA delegation consisted of H. W. Stuart, Director of Quality Control of the United States Pipe & Foundry Co., chairman of ASTM Committee A-3, on Cast Iron, and H. W. Lownie, Jr., Research Metallurgist of the Battelle Memorial Inst.

The following Resolutions were adopted in accordance with previously prepared documents and following a thorough discussion of the subject.

Resolution 1. ISO 25 should take into account the relevant activities of other international organizations and of the ISO Technical Committees concerned with the utilization of cast iron. It will endeavor to ensure coordination, in particular with ISO 17—Steel, the International Committee of Foundry Technical Assns, and Working Group No. 5 of European Coal and Steel Community.

Resolution 2. The scope of ISO 25 comprises standardization of foundry pig iron and cast iron with a view to facilitating international trade; to this end the relative national standards will be reviewed, in particular for the coordination of nomenclature, definitions, and methods of test.

Resolution 3. The program of work of ISO 25 is as follows:

1. Terminology
2. Definitions, classification of, and symbols for foundry pig iron and different types of cast iron
3. Methods of mechanical testing (taking into account the work of ISO 17—Steel and of the International Committee of Foundry Technical Assns.) and methods of physical and chemical testing, including tension, impact, transverse, and other tests.
4. Standards for cast iron of the following types: gray cast iron, malleable cast iron, and cast iron with spheroidal graphite.
5. Specifications for raw materials: pig iron, scrap iron (internal scrap and purchased scrap), and steel scrap.

The drafting of proposals for the tension testing of gray cast iron was discussed in detail.

The ASTM Specification for Gray Iron Castings (A 48) (ASA No.: G25.-1—1948) was submitted by the U. S. delegation for consideration where applicable and it is felt that reasonable progress was made in making the ISO draft specification applicable to U. S. practice.

Dr. Collaud, a delegate from Switzerland, presented a discussion of his paper, "New Suggestions for the Standardization of Gray Cast Irons" and it is believed that ISO 25 will become a valuable means for exchanging practical information. Many delegates requested American Standards, and it was agreed that a more thorough exchange of existing standards is needed. As an example, it was argued at one stage that no country had specifications for foundry pig iron. ASTM Specifications for Foundry Pig Iron (A 93) have been in existence since 1904 and were revised in 1955.

Much interest was shown in spheroidal graphite cast iron. This iron is referred to as ductile or nodular cast iron in this country, and it is obvious that standardization of terminology is needed. This type of cast iron will be the subject of prompt task force study and the U.S.A. delegation indicated active interest in the preliminary work.

Members of the delegation that attended the meeting have expressed the conviction that much technical and economic value will come from continued participation in ISO 25.

ISO 27 on Coal and Coke

At a meeting of the Advisory Subcommittee of ASTM Committee D-5 on Coal and Coke at the Battelle Memorial Inst., Columbus, Ohio, held on October 21, Messrs. W. A. Selvig and O. W. Rees reviewed the Fourth International Meeting of ISO 27 on Coal and Coke which met in June in Stockholm, Sweden. Delegates from sixteen countries had attended.

The ISO meeting considered methods for the standardization of coal analyses for the determination of moisture, ash, volatile matter, carbon and hydrogen, sulfur, forms of sulfur, swelling and coking tests for evaluation of coking characteristics, phosphorus, chlorine, arsenic, tar yields from brown coal and lignites, and determination of mineral matter in coal. The committee also agreed to organize working groups to study methods of determination of moisture in coal by azeotropic distillation, the determination of ash in brown coals and lignites, determination of arsenic in coal, determination of fusibility of coal ash, and physical tests for coke. A subcommittee is to be formed to consider the subject of terminology in coal washing processes, and methods of expressing results of coal washing tests.

Special working groups were appointed to review moisture determination, the representatives of Committee D-5 agreeing to conduct experimental work in connection with the use of small oven heating in air to produce accurate results for moisture determination. Messrs. Selvig and Rees reviewed the impressive amount of research work which is made available to each committee through active participation in the ISO technical committee.

At the close of the ISO meeting, Mr. Selvig attended the eleventh session of the Classification Working Party, Coal Committee, Economic Commission for Europe, held June 29–July 1, in Geneva, Switzerland. At this meeting there were in attendance delegates from fifteen countries.

The Classification Working Party completed a classification system for all coals of rank higher than lignites and brown coals which is similar to the Standard Specification of Coals by Rank (D 388) except that it is more detailed in that it makes use of coking properties for the grouping together of similar coals. The Classification Working Party is currently engaged in obtaining data on European brown coals and American lignites in an effort to formulate the classification for low-ranking coals.

Discussion of the interest of America in the work of ISO 27 developed general agreement that attempts should be made to arrange further cooperative test work, using industrial laboratory personnel to supplement activities in research laboratories such as those of Government agencies.

Gaillard Seminar on Standardization

At the Gaillard Seminar on Industrial Standardization to be held January 23 through 27, 1956, in New York City, four out of the ten conferences will be devoted entirely to the subject, Company Standardization. Other major topics will be analysis of standardization and its application to engineering and management; forms of standardization, such as simplification, unification, and design of standards; and the art of writing specifications.

Leader of the seminar is Dr. John Gaillard, formerly a member of the staff of the American Standards Assn. and a lecturer at Columbia University. He is now a management counsel specializing in problems of standardization.

Further information may be obtained from Dr. Gaillard, 400 W. 118 St., New York 27, N. Y. Places at the seminar may be reserved in advance.

Random Samples...

FROM THE CURRENT MATERIALS NEWS

From the broad stream of current materials information flowing from "in-box" to "out-box" in a busy editorial office, random samples (mostly random) have been plucked. Thinking them worth re-showing to ASTM'ers who may have missed the original articles, we have included them here. Of course, we had to trim the samples to fit. There will be those who are not satisfied with samples, especially ones which are not really random. But these ASTM'ers can contact the institution, magazine, governmental agency, etc., who placed the original information in the stream, or address Random Samples, ASTM, 1916 Race St., Philadelphia 3, Pa.

Plastics With Coats

ANNOUNCEMENT of a revolutionary new process for providing corrosion-resistant coatings of polyethylenes, polyfluorocarbons, nylon, and other plastics on metallic and dissimilar plastic molded targets, was announced recently by the American Agile Corp., Maple Heights (Cleveland), Ohio.

Until this time, certain targets could be coated with polyethylene to provide corrosion-resistant surfaces by using special spraying equipment. However, many additional targets could not be sprayed because of their small size or irregular shape.

The new process, known as the fluidized-coating process, was displayed for the first time at the 25th National Chemical Show, December 5 to 9, in Philadelphia.

According to J. A. Neumann, Agile President and Director of Research, "the fluidized-coating process, a brand new concept in coating techniques, fills the last major gap in the anti-corrosion coating field. It will enable industry to apply on-the-spot corrosion protection when and where it is needed, at an exceptionally low cost, and in 50 per cent less time than was required with spraying."

The process involves the use of a powder fluidizer, a compact unit consisting of a specially designed gas distribution system which maintains the plastic powder in a turbulent dense fluid state. The appearance of the fluidized bed closely resembles that of a boiling liquid.

Also available is a line of specially blended polyethylene coating powders, developed by American Agile, which can also be used with a spraying unit where this process may be utilized.

The fluidized-coating process provides a uniform coating up to $\frac{1}{8}$-in. thick. The target to be coated is first preheated to predetermined temperature then immersed in the fluidized coating powder for from 10 to 15 sec. It is then replaced in the oven, and allowed to cure for a short period.

The process, at this particular time, will be available for use only in laboratories for coating such items as stirrers, valves, containers, racks, and handling tools, which can be given a firmly adherent corrosion-proof cladding of resin in a matter of a few minutes. Within the next few months, as larger coating units are built, applications to industry in general will be possible.

Dr. Neumann added that "expected additional applications for the new process include the coating of exterior surfaces of such items as pipe which require corrosion-resistant protection but which must withstand pressures beyond the capacity of polyethylene pipe; flasks and containers with small-diameter neck openings, yet whose interiors require corrosion protection; flat but highly irregular shapes such as propellers, mixing blades, coaxial fans and rotors, and the like."

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"Bang" Bolts

AN UNUSUAL method for increasing the strength of bolted joints when subjected to shock loads was presented by Oran A. Pringle, Assistant Professor of Mechanical Engineering at the University of Missouri, at the Annual Meeting of The American Society of Mechanical Engineers in Chicago, November 13 to 18. The paper was prepared by Prof. Pringle and John Love, Jr., former Assistant Professor of Mechanical Engineering at the University and now with the General Electric Co. at Norwood, Ohio.

The method involves the removal of a precise amount of material from the shank of the bolt, thus reducing the shank to certain optimum sizes which depend on the type of bolt, method of manufacture, and heat treatment.

Although bolts modified in this way weigh less than their original form, their capacity to absorb impact energy is several times greater than ordinary bolts. This property may prove valuable in the construction of combustion engines, railroad car carriages, rock crushers, and other machinery where parts are subject to sudden and repeated shock loads.

In addition to the remarkable increase in impact strength, the modified bolt with the reduced shank permits greater stretching or elongation during tightening. Consequently, the nut is less likely to loosen because of vibration. Also, resistance to fatigue failure is increased so that the bolt will last longer in rough service.

The reduced weight and increased strength plus the vibration-defying qualities of the modified bolt could prove valuable to the aircraft industries.

The paper, which is based on results of research conducted by the Mechanical Engineering Department and the Engineering Experiment Station of the University, is entitled "The Influence of Shank Area on the Tensile Impact Strength of Bolts."

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Aluminum Pipe Goes Underwater

THE voracious appetite of a small aquatic animal called the teredo has prompted construction of the world's first permanent underwater oil pipeline of aluminum.

The 1000-ft line recently was welded and submerged in Lake Maracaibo, Venezuela. Engineered by Creole Petroleum Corp. with the assistance of Aluminum Company of America, the aluminum pipe installation will carry crude oil from an underwater well of Creole's Bachaquero Field to a flow station on the lake shore.

The pilot installation of aluminum pipe came after a protective coating applied to a steel pipe installation was attacked by the barnacle-like teredo. With the coating damaged, the ferrous metal was exposed to corrosive action by Lake Maracaibo's brackish waters.

Aluminum, highly resistant to salt water corrosion, was selected to combat the teredo. Alcoa, successful operator for over five years of the first undersea

aluminum gas line in Matagorda Bay, Tex., was called on for technical assistance. Approximately 700 ft of Alcoa aluminum 4-in. Schedule 40 pipe was submerged to carry oil at a depth of 15 to 20 ft below the lake surface.

The aluminum pipe was anchored to the lake bottom with 280-lb concrete weights set 40 ft apart. At each end of the line, aluminum pipe risers emerge vertically from the bottom. One terminal is connected to the wall, the other to the flow station. Test sections have been installed in each riser to allow easy, periodic examination of the line.

Prior to this pilot installation, Alcoa's Aluminum Research Laboratories were called on to predict the corrosion resistance of aluminum alloys to the waters of Lake Maracaibo and to the crude oil produced by the well. Since the lake connects with the sea, the water is slightly salty or brackish. Exhaustive tests indicated that aluminum would offer long life for this application.

Aluminum risers are reported to have been used on some of the steel lines in wells operated by Creole in the Lake Maracaibo oil fields for periods exceeding ten years.

The pipe was welded with an inert gas-shielded, tungsten metal arc machine.

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A Hot Tip

A BERYLLIUM-copper plunger tip on a 450-ton, cold-chamber, die-casting machine at Ohio Die Casting Co., Columbus, still is in good condition after more than 510,000 cycles—enough use to have worn out 70 tips made of a previously used material.

The Columbus, Ohio, firm uses the beryllium-copper tip for such jobs as forming locknuts for the plumbing industry from molten aluminum at the rate of 150 to 160 cycles per hour. The 2-in. diameter plunger tip operates in a sleeve to force 20-oz shots of hot aluminum (1200 F) into a die.

The tip is 4 in. long by 2 in. in diameter and is made of Berylco No. 10, supplied by The Beryllium Corp., Reading, Pa. The beryllium-copper alloy tip is hot-rolled, annealed, turned, and heat treated.

Ohio Die Casting discovered that the use of the beryllium-copper tip not only permitted highly desirable closer tolerances—0.0005-in. clearance for the Berylco tip against 0.001-in. clearance for other alloys—but that the result of cutting the tolerance in half actually doubled the life of the beryllium-copper tip.

The firm uses a water cooling system to keep the tip cool and tight in the sleeve. When a beryllium-copper tip is first placed in use the water cooling rate is increased as much as possible. As the tip starts to wear, the cooling rate is reduced so that the heat expands the tip to fit more tightly in the sleeve.

By controlling the cooling system in this way, Ohio Die Casting is able to maintain the initial close tolerance for the life of the plunger tip. It is significant that, even with the closer tolerances and the longer use of beryllium-copper tips, the firm has never had a tip stick. All other types of tips have stuck in the sleeve at one time or another despite the fact that they were given twice the tolerances of beryllium-copper tips.

The ability of beryllium-copper to conduct and dissipate heat is shown in an operating experience that Ohio Die Casting reports but does not endorse as good practice. The plunger tip that is still in use, having made over 510,000 cycles without failing or sticking, was once run for an 8-hr shift without any water cooling at all. Under this severe condition the plunger tip worked satisfactorily, did not stick, and showed no evidence of serious wear.

The advantages of beryllium-copper for use in such critical components as plunger tips stem from the unique combination of physical properties characteristic of the alloy. Beryllium-copper combines excellent thermal conductivity with tensile strength, endurance, and wear resistance comparable to that of steel. These last features provide advantages in plunger tip operation. As the tip moves in to feed the aluminum to the die, the impact tends to peen the edges of the tip outward against the sleeve. This is a desirable effect, since it tends to preserve the close tolerances.

As the tip wears, it feathers at the inlet end around the plug. When this feathering becomes excessive, the tip is removed, the edges are pounded out with a hammer and the tip is re-turned so it will again fit the sleeve.

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Pole Protection via Aluminum Sheet

WOODEN poles that support transmission lines along the Minnesota River are finding protection from the threat of brush fires in a base sheathed with aluminum sheet.

These transmission lines, installed by a utility in the Upper Midwest, are threatened by fire at certain seasons of the year because of a heavy growth of weeds in the area. A complicating factor is that pilings used to support the poles are treated with creosote and, unless protected, quickly ignite even in flash fires.

Pilings are arranged three to a transmission pole and are bonded individually to the main pole. In the interest of strength and stability, they are driven into the ground to depths up to 50 ft. About 15 ft of each piling remains exposed above ground and must be protected.

To prevent destruction by fire, the creosoted piling has been covered with aluminum. Sheets of Alcoa alloy 3003-H14, 4 by 12 ft in dimension and 0.032 in. in thickness, are wrapped around the piling and secured with standard, spiral shanked, neoprene-washered, aluminum roofing nails. This combination of aluminum sheet and nails provides a lightweight, easy-to-handle covering that will give long-lasting protection.

Alcoa Aluminum News Letter, November, 1955

Graduate Plastics Program Fellowships at Princeton

AN ENGINEERING curriculum of graduate study and fundamental research in plastics leading to the degree of Master of Science in Engineering is offered by Princeton, N. J.

Instruction covers properties, evaluation, production, fabrication, design and application of materials as well as chemistry of plastics. Program includes lecture and laboratory classes, and contact with industrial plants representing various interests of the plastics industry.

Fellowships with stipends of from $1500 to $2100 plus tuition and fees are available. Opportunities for employment as half-time Research Assistants at $1500 per academic year are also available to students not on fellowships.

Applicants for admission must hold a Bachelor's degree in engineering or physical science from a recognized institution and must meet general admission requirements of the Graduate School of Princeton University.

For information, address:

LOUIS F. RAHM, *Director*
Plastics Laboratory
30 Charlton Street
Princeton, N. J.

Department of Defense Encourages Consideration of Low-Nickel, Manganese Stainless Steels

By Franklin P. Huddle[1]

Nickel has been so tight throughout 1955 that deliveries to the National Stockpile have been diverted to meet current industrial needs at the rate of about 1,000,000 lb a month. For all national purposes, this signifies a shortage of nickel. In view of the continued expansion of our economy and the increasing use of nickel for technological needs, the tight situation in the metal bids fair to become chronic.

From the point of view of the Department of Defense, it appears that private industry could contribute significantly to national preparedness and, at the same time, reduce the hampering effect of nickel insufficiencies at this time by exploiting the potentialities of low-nickel, manganese stainless steels to the greatest possible extent.

The major steel companies are cooperating in awakening the interest of consumers in these steels. Base prices of two new 200-series stainless steels are currently quoted at two cents less per pound than those of comparable 300-series steels. This is a price reduction of about 4⅞ per cent, which should make these new steels very attractive to industrial users. From the standpoint of raw material availability, there is little possibility that wholesale acceptance and use of low-nickel, manganese stainless steels will result in any future shortage of manganese.

TABLE I.

AISI Type	Carbon, Max	Manganese	Phosphorus Max	Sulfur, Max	Silicon, Max	Chromium	Nickel	Nitrogen, Max
No. 201	0.15	5.5–7.5	0.06	0.030	1.00	16.0–18.0	3.5–5.5	0.25
No. 202	0.15	7.5–10.0	0.06	0.030	1.00	17.0–19.0	4.0–6.0	0.25

About two-thirds of all nickel-bearing stainless steels produced during the first six months of the present year would have been possible candidates for the substitution of low-nickel manganese stainless steels: 225,000 ingot tons out of 325,000 ingot tons of all nickel-bearing stainless steels poured.

[1] Conservation Specialist, Office of Assistant Secretary of Defense (Applications Engineering).

[2] A limited number of copies of Mr. Bennett's report are available for distribution to industry. Requests may be addressed to the Executive Secretary, Materials Advisory Board, National Academy of Sciences–National Research Council, 2101 Constitution Ave., Washington 25, D. C.

These include the AISI 301 and 302; and to a lesser extent, 304. Major consumers of 301 are railroads and automotive equipment which use more than one-half of all 301 stainless steels produced in this country. Major users of AISI 302 are aircraft and domestic appliances which take nearly one half of this type of steel. In 304 stainless, the major consumers, also taking about half the total produced, are aircraft, automotive, food processing, and special-purpose industrial equipment.

An appraisal of the manganese-type stainless steels was undertaken earlier this year at the request of the Department of Defense by the Materials Advisory Board, National Academy of Sciences–National Research Council. A staff study on this subject, prepared by Edmund V. Bennett,[2] was transmitted to the Department of Defense on June 10, 1955.

Bennett found that although there were moderate difficulties with the production of manganese-type stainless steels, fabrication offered no special problems and that these steels, where properly applied, have performed satisfactorily in use. Two low-nickel, manganese compositions on which Bennett reports favorably have recently been established as standard by the American Iron and Steel Inst. under AISI designations 201 and 202. Chemical compositions for these steels are given in Table I.

Bennett concludes that "201 seems to be entirely adequate as a substitute for 301," and that "202 may be considered an alternate steel for all 302 applications except those involving some types of chemical corrosion." He adds that in a few cases 202 may also prove an acceptable alternate for 304. In summary, Bennett says: "It is felt that 201 and 202 are steels of proven merit and that everything possible should be done to encourage their use."

From the fabrication standpoint, the new compositions are slightly higher in yield strength (on the order of 10 per cent) than comparable 300-series stainless steels. As to machinability, they are roughly comparable. Welding presents no problems.

In view of the fact that the military services are actively engaged in a search for alternate, less critical engineering materials suitable for mobilization use and many private industrial companies are voluntarily engaging in counterpart programs on their own, expanded use of these low-nickel, manganese stainless steels seems definitely called for in the interest of the national security.

Control of Cracks in Reinforced Concrete

Detailed information on the cracking of loaded concrete beams and slabs is now available as a result of recent investigations[1] at the National Bureau of Standards. The data promise to prove useful in controlling the spacing and width of cracks in the future design of reinforced-concrete structures. In general, the results show that width of cracks can best be controlled by using a large number of small reinforcing bars and by increasing the ratio of reinforcement.

The investigation was carried out in the NBS structural engineering laboratories under the American Iron and Steel Inst. Research Fellowship.

[1] For further technical information, see A. P. Clark, "Investigation of Cracking in Reinforced-Concrete Flexural Members," *Journal*, Am. Concrete Inst.

The Bookshelf

Electrons, Atoms, Metals and Alloys

William Hume-Rothery, Philosophical Library, New York, N. Y., 387 pp., $10.

THE pace of modern science is such that many engineers have difficulty keeping up with new advances even in their own fields. With this idea in mind, Hume-Rothery, a recognized authority in the metals field has written a sugar-coated volume to help the older practical metallurgist become better acquainted with the modern atomic theory of metals. The book is also very valuable to the technically trained but nonmetallurgical reader who is interested in learning about the atomic structure of matter but to whom a rigorous treatment is unpalatable.

The book is sugar coated in that it is written in easy dialogue style as a serious conversation between an older metallurgist and a young scientist. In the preface, the author admits that he had some difficulty in avoiding a straight question and answer type of dialogue. That he succeeded admirably in writing in an interesting manner about a difficult subject is evidenced by the fact that this reviewer, a nonmetallurgical reader, was reluctant to put the book down when other duties called. For those who wish to go on to more rigorous treatments of the subject, the author has listed at the ends of the chapters a number of suggestions for further reading.

The book is divided into four main parts: I—The Nature of an Atom; II—The Nature of a Metal; III—The Nature of an Alloy; and IV—The Structure of the Nucleus. The author refers liberally to experiment and frequently gives fundamental mathematical relationships. It is unfortunate that in such a treatment as this is, the author was in many cases unable to get across in words a clear picture of some of the sub-atomic concepts. Perhaps this is just as well since abstractions by their very nature are incapable of explanation in terms of physical models. Even so, to this reviewer, the book has fostered a clearer comprehension than before of quantum energy levels, Heisenburg's principle, and wave mechanics.

Part II on "The Nature of a Metal" seems less formidable than "The Nature of an Atom" since one can visualize the crystal structure of metals as a physical entity. The arrangement of atoms in a crystal need only be scaled up to give a clear picture of what is meant. The action of metallic crystals in diffracting soft X-rays and so revealing their physical dimensions is easily understood at least qualitatively from the treatment given. In this section too, the fundamental differences between metals, insulators, and semiconductors were explained in terms of Brillouin Zone theories and wave mechanics and involving the actions of electrons. These electrical and electromagnetic phenomena cannot be explained on a basis of "common sense" dynamics and the author found it necessary to explain them on a basis of wave mechanics.

Plastic deformation in metals was handled in an interesting manner, and the theory of dislocations and slip in crystal planes was explained with the aid of diagrams and photographs.

Alloys were treated in Part III with liberal use of phase diagrams to indicate the character of alloys with various compositions and under different conditions of temperature. Throughout the book, an attempt was made to relate the observations on metals to the atomic theory of metals. Although in some cases this was not possible because of the present state of the science, it was usually done with convincing clarity.

Following a short section on structure of the nucleus, the author points out in his conclusion that metallurgy, though one of the oldest of the arts, is one of the youngest of the sciences. He indicates that there is immense practical value which can come from a general understanding of the fundamental science of metals by metallurgists. F. Y. S.

Design of Blast-Resistant Construction for Atomic Explosions

THE AMERICAN Concrete Inst. has reprinted this 96-page paper by C. S. Whitney, B. G. Anderson, and E. Cohn. Reprinted from the March, 1955, *ACI Journal*, it is now available, in covers, for $1 from ACI headquarters, 18263 W. McNichols Rd., Detroit, Mich.

The work reported in this paper was done under contract with the Office of the Chief of Engineers, Department of the Army, as part of the research program that began in the ruins of Hiroshima and Nagasaki following cessation of hostilities in Japan. In many respects, these tests probably exceeded the scope of any single previous research program on building construction.

Part of this program was to determine by theoretical analyses and physical tests how particular structures would behave under blast loads. The data accumulated in the tests have furnished useful information on the behavior of structures and materials under all types of loads, including atomic bomb blasts.

The results of the research and the data indicated high vulnerability of present buildings found in American cities if subjected to atomic attack. However, it was also demonstrated conclusively, by full scale tests, that structures can be designed to resist the effects of atomic explosions.

The paper presents methods and principles used in designing the first full scale blast-resistant structures tested at Eniwetok together with results of those tests. Radiation hazards and methods of dealing with them are described.

Four appendices, comprising a major portion of the paper, give detailed procedures for computing the blast loading, for designing individual structural elements and single multistory buildings in both the elastic and plastic range for this loading, for computing ultimate strength of structural elements and frames under rapid loading, and for dealing with some special problems.

Units of Weight and Measure—Definitions and Tables of Equivalents

National Bureau of Standards Miscellaneous Publication 214, Government Printing Office, Washington 25, D. C. 64 pp., 40 cents.

THIS publication defines the units of length, mass, area, volume, and capacity in use in the United States. It also gives tables of interrelation and tables of equivalents for these units in the metric system and in the U. S. customary system.

In addition, the volume contains sections of the fundamental equivalents, the approved spelling and abbreviation of each of the most common units of weight and measure, and the status of the metric system in the United States. All of the tables and other material have been revised to conform to current definitions, equivalents, and usages. Conversion tables are confined to simple units, excluding all compound units such as foot-pounds, pounds per cubic foot, and feet per second.

For this revision, tabular values involving the liter have been changed to the basis 1 liter = 1.000 028 cubic decimeters and the international nautical mile of 1852 meters, as adopted by the Departments of Defense and Commerce on July 1, 1954, has been substituted for the U. S. nautical mile. The publication should prove useful in scientific, industrial, commercial, and other fields.

OTS Research Reports

Office of Technical Services, Department of Commerce, Washington 25, D. C.

Heat Transfer Fluids for Aircraft-Equipment Cooling Systems

DATA are presented for 36 fluids in this report of research done by Ohio State University for Wright Air Development Center. Fluid types represented are aqueous solutions, hydrocarbon fuels, hydraulic fluids and lubricants, oxygenated hydrocarbons, fluoro- and chloro-hydrocarbons, organic-inor-

ganic compounds and silicones. Water is used as a reference fluid since it has the most desirable properties for use as a forced convection heat transfer medium up to 600 F. It is unsuitable, however, because of its high freezing point.

Among fluids having a freezing point of −65 F or lower, aqueous solutions are found to be more desirable. In addition to their other qualities they increase the gross weight of aircraft only slightly more than does pure water. 183 pp., $4.75.

Rubber for Service in Contact with Experimental Hydraulic Fluids at 400 F.

This report describes the testing, milling, and compounding procedures used in developing a superior heat- and fluid-resistant rubber compound to function for long service periods, at temperatures ranging from −65 to 400 F in the hydraulic systems of supersonic aircraft. Best results were obtained with compounds of Neoprene WRT aged in a silicate ester base hydraulic fluid. These compounds are believed to be processable on industrial equipment such as mills and extruders. Tables show comparative physical properties, both aged and original, of the various compounds tested and the experimental aging fluids used. 15 pp., 50 cents.

Synthetic Lubricants

This study contains a survey of the potential availability of raw materials from which ester-type lubricants can be made; and an evaluation of many types of esters to determine their suitability as lubricants for high-power aircraft engines.

The first part of the program included a survey of data from the literature on over 800 compounds, chiefly esters. Most available of these were adipic acids—chain-type dibasic acids which can be derived from petroleum—and Oxo alcohols. Another promising source of synthetic oil appeared in polypropylene glycols.

In the second phase of this study many types of esters were evaluated for properties which would make them desirable as lubricants for aircraft equipment. These include good viscosity-temperature and viscosity-volatility relationships; low melting and pour points; stability toward oxidation, hydrolysis, and heat; and good lubrication characteristics. 168 pp., $4.25.

Effect of Purification of Commercial Sulfonates on Their Corrosion-Stain Property

Experience has indicated that preservative compounds containing sulfonate inhibitors frequently leave stains which seriously reduce corrosion resistance, especially in precision ground parts.

In experiments described in this report, the trouble was traced to water-soluble sulfonates and inorganic salts. Extraction of water- or oil-soluble sulfonates presents particular difficulties, however, since they cannot be removed with the usual organic solvents. A special process was devised in which sulfonates were de-oiled and purified by extracting the solution with toluene. Tests in humidity and fog cabinets indicated that the extraction procedure materially reduced staining and improved the protective ability of the inhibitors. 20 pp., 50 cents.

Tests of Anchors for Mass Concrete Forms

Technical Memorandum No. 6-399, Waterways Experiment Station, Corps of Engineers, U. S. Army, Vicksburg, Miss., 50 cents.

This report describes tests intended to determine the holding strength of several designs of anchors for securing cantilever forms to mass-concrete surfaces. The investigation consisted of the fabrication of four blocks of low-strength 6-in. aggregate concrete in which a total of 48 anchors were embedded and tested at ages ranging from 24 to 72 hr. Results indicate that, under the test conditions used, adequate holding strength was developed in practically every case by the time the concrete was 3 days old.

Tests of Weighing and Recording Equipment for Concrete Batching

Technical Memorandum No. 6-407, Waterways Experiment Station, U. S. Army Corps of Engineers, Vicksburg, Miss., $1.

The report describes tests conducted for the Office, Chief of Engineers, to determine the extent to which available commercial weighing and recording equipment complied with the requirements of the "Standard Guide Specifications for Concrete" and to develop standardized requirements for such equipment used in the production of concrete for the Corps of Engineers. Tests showed that none of the manufacturers' equipment met all of the requirements of the then current "Standard Guide Specifications for Concrete"; however, parts of each plant did comply with these specifications.

Dechema-Werkstoff-Tabelle

E. Rabald and H. Bretschneider, Eds., Dechema, Frankfurt a.M., 100 sheets, DM 0.30 per sheet.

Part 4 deals with the resistance to chemical attack of a large number of materials. The tables are further supplemented by brief notes embodying the experiences of more than 25 years in the field.

The greater portion deals with the action of calcium salts. Calcium sulfite is dealt with at great length, particularly corrosion occurring in sulfite cookers. Calcium hypochlorite is also treated in accordance with its application as a disinfectant, an oxidizer, and as a bleaching agent.

How to Train Engineers for Industry

Professional Engineers Conference Board for Industry, 1121 15th St., N. W., Washington 5, D. C., 82 pp., $2.

This mimeographed report is the result of the fourth of a series of Executive Research Surveys, begun in 1951 by the Professional Engineers Conference Board for Industry with the cooperation of the National Society of Professional Engineers. It reflects the experience of more than 200 companies which employ engineers, as well as of many individual leaders in the training field.

The purpose of the research program is to assemble and publish current information on engineer-management relations for the benefit of industrial employers of engineers and the engineering profession.

The topics under study were selected by some 100 major industrial employers of engineers. During a preliminary study, these employers were asked to select from a list of management problems those subjects on which they would like to have data derived from the experience of many companies, and from the engineers employed by those companies.

International Journal of Abstracts on Statistical Methods in Industry

Vol. 1, No. 1, G. I. Butterbaugh, Ed., International Statistical Institute, 2 Oostduinlaan, The Hague, Netherlands, 39 pp., $1.

This bibliography will be issued three times a year with about 100 abstracts in French or English, in each issue. It is intended to cover papers and books published in all parts of the world.

The abstracts are printed on one side of thin cardboard. Three abstracts make up a page which can be cut into three parts of 3 by 5 in. each for arrangement into a card index system.

Annual subscription price is $2.50.

The Defense Materials System in Our American Industry

Business and Defense Services Administration, U. S. Department of Commerce, Field Offices, 25 cents.

This 41-page booklet describes the "functioning material control system designed to permit rapid industrial mobilization in case of war." Its purpose is to acquaint industrial contractors and subcontractors of the Department of Defense and the Atomic Energy Commission with the greatly simplified rules and regulations governing such contracts.

Key questions and answers on the essential points of the Defense Materials System precede the detailed description and instructions for defense contractors.

(Continued on p. 65)

A Remotely Operated Extensometer*

By R. G. Berggren and J. C. Wilson

A sensitive extensometer for use in remotely controlled tension testing of radioactive metallic specimens.

A REMOTELY operated extensometer was developed to facilitate strain measurements on highly radioactive specimens during tension testing. Certain features of this extensometer may offer unique advantages in conventional tension testing of nonradioactive specimens.

Tension testing of radioactive materials usually must be done in shielded enclosures designed to decrease radiation levels to safe values. A typical enclosure for this work, called a "hot cell" or "cave," has high-density concrete walls 3 ft thick containing windows of the same thickness, filled with zinc bromide solution.

Tension testing operations that are normally done with the hands must, when conducted in a hot cell, be performed by means of mechanical or electrical manipulators of various types. Some manipulators are fairly good substitutes for hands, but even the best do not provide a good sense of touch at low forces, and some play or lag is always present.

Attaching any of the excellent commercial extensometers to a test specimen requires some skill and involves a sense of touch and close visual observation. The individual conducting a remote tension test is 5 ft or more from the specimen and is further handicapped by having to use remote control manipulators. Under these conditions, applying the usual extensometer to a specimen becomes a very difficult and often tedious task. Commercial extensometers have other disadvantages under such conditions: high sensitivity usually is associated with short range; long range is usually accompanied by low sensitivity; types that may be left on to fracture usually separate into two parts that are difficult to reassemble by remote control; and some modification is required to adapt them to varied sizes and shapes of test specimens.

The desirable features of an extensometer for use on radioactive specimens appear to be as follows:

1. Application and removal of the extensometer must be rapidly accomplished by remote control, preferably without the use of remote control manipulators.
2. It must be usable on a variety of specimen sizes and shapes with little or no modification.
3. It must be sufficiently rugged to withstand rough handling and should withstand specimen fracture without damage.
4. Sensitivity should be at least as high as commercial units, and high sensitivity should be attainable with long range.
5. The extensometer should, upon removal from the specimen, automatically return to its initial gage length setting and be ready for the next test.
6. Data from the extensometer should be recorded continuously, and means should be provided to change the strain magnification and zero scale suppression during the test.
7. Calibration should remain constant, and means should be provided for checking calibration from the control position.

Equipment

Mechanical Design

The general mechanical design features of the extensometer designed and built to satisfy the requirements listed above are shown in Figs. 1 and 2. The extensometer base is mounted on the lower grip or crosshead of the tension testing machine. A yoke, carrying the two lever arms, is mounted on the base and is rotatable about a vertical axis. The lever arms are first-class levers with a 1:1 ratio. Each arm has a knife edge at one end to contact the specimen, and one of the two components of the displacement transducer is attached at the other end. The rotation axes of the lever arms are vertically displaced by a distance equal to the gage length of the extensometer. The model shown in the figures has a gage length of ½ in., and the distance from the point of contact between the knife edge and specimen to the centerline of the transducer is 6 in. The rotation axis of each lever arm is at its midpoint. A gage length of ½ in. was selected to fit the smallest specimens to be tested. There is no disadvantage in using an extensometer of such gage length on longer specimens unless data are required after necking begins.

To bring the knife edges in contact with the specimen, the yoke carrying the lever arms is rotated about its vertical axis by a spring which is opposed by a cable wound on the capstan of a low-speed motor. Reduced sections

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J. C. WILSON, Group Leader in Radiation Metallurgy, Solid State Division, Oak Ridge National Laboratory, has worked on materials testing problems associated with radioactive materials for five years.

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* Presented at the Fifty-Eighth Annual Meeting of the Society, June 26–July 1, 1955.

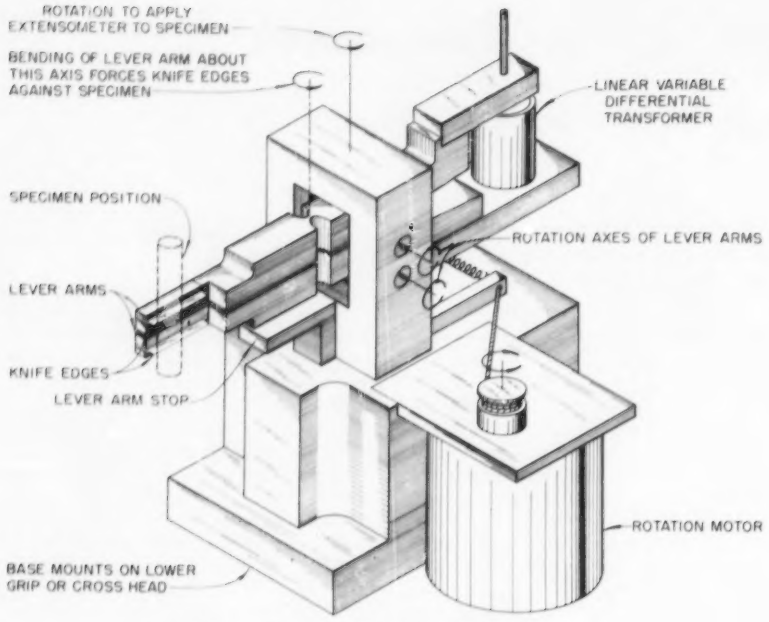
ROTATION TO APPLY EXTENSOMETER TO SPECIMEN
BENDING OF LEVER ARM ABOUT THIS AXIS FORCES KNIFE EDGES AGAINST SPECIMEN
LINEAR VARIABLE DIFFERENTIAL TRANSFORMER
SPECIMEN POSITION
ROTATION AXES OF LEVER ARMS
LEVER ARMS
KNIFE EDGES
LEVER ARM STOP
ROTATION MOTOR
BASE MOUNTS ON LOWER GRIP OR CROSS HEAD

Fig. 1.—Remotely Controlled Extensometer.

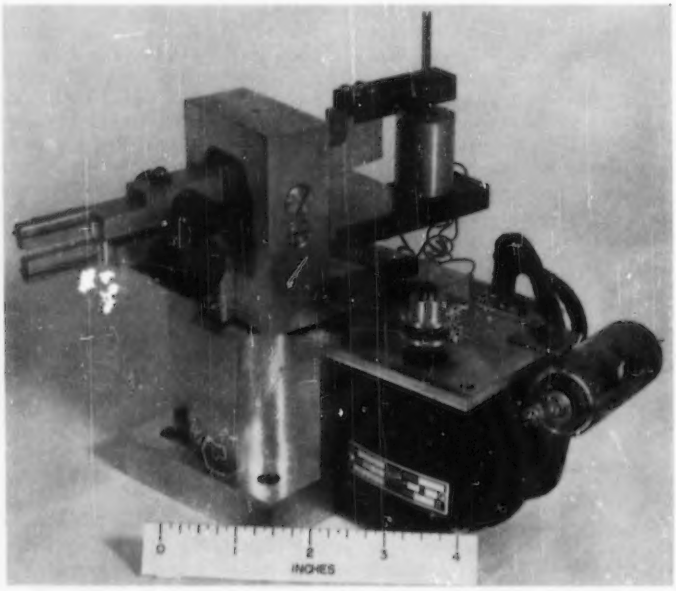

Fig. 2.—Pilot Model of Remotely Controlled Extensometer.

in the lever arms provide flexibility about a vertical axis so that, as rotation of the yoke continues beyond the position of initial contact between knife edges and specimen, the forces on the knife edges increase, the lever arms bend slightly, and small initial misalignment of the knife edges does not prevent good contact of both knife edges with the specimen. The force exerted on the specimen by the knife edges is controlled by the coil spring, the rotation motor position, and the rigidity of the lever arms. With a force sufficient to produce slight bending of the lever arms, good results have been obtained on specimens ranging from aluminum through hardened steel. Sharpness of the knife edges does not appear to be critical. The use of knife edges, as shown in the figures, permits use of the extensometer on a wide range of round and flat specimens without modification or adjustment, and, together with the rugged construction, permits fracturing of the specimen without damaging the extensometer. The present embodiment of this extensometer has been used on round specimens from 0.125 to 0.375 in. diameter and on flat specimens 0.06 to 0.125 in. thickness. The center rotation axes of the lever arms are supported in miniature radial ball bearings housed in the yoke and preloaded to eliminate play. The lever arm ends opposite the knife edges carry the two movable components of the transducer, a linear variable differential transformer. Relative movement of the knife edges causes a similar motion of the transducer core, mounted on the upper lever arm, relative to the other transducer component, mounted on the lower lever arm. This produces a change in output voltage of the transducer in the order of 0.005 v per 0.001 in.

To remove the extensometer from the specimen, the cable is rewound on the motor capstan, rotating the yoke and removing the knife edges from the specimen. The lever arms are weighted to produce a slight downward force on the lever arm ends carrying the knife edges. Thus, when the knife edges are removed from the specimen, the end of the lower arm bearing the knife edge drops to a position determined by an adjustable stop mounted on the yoke, and the corresponding end of the upper lever arm drops to a position relative to the lower lever arm determined by an adjustable stop. This resets the distance between the knife edges to the gage length, and the extensometer is ready for the next test. If the specimen has a uniform elongation in excess of the extensometer range, it is possible to remove and reapply the extensometer in a few seconds, thus returning the extensometer to the original gage length. This can be repeated several times and the separate extension recordings combined to produce a complete record of the test.

Transducer

The extensometer design produces no mechanical magnification. Therefore, a transducer was required that had high sensitivity, a relatively long linear range, and ability to function in a linear manner in spite of the nonlinear motion of the upper lever arm at high strains. A linear variable differential transformer or microformer[1,2] was used as the trans-

[1] H. Schaevitz, "The Linear Variable Differential Transformer," *Proceedings*, Soc. for Experimental Stress Analysis, Vol. 4, No. 2, p. 79 (1947).

[2] A Schaevitz Engineering Co. Model 18-LCT linear variable differential transformer was used; suitable units are also manufactured by O. S. Peters, Inc., and a transformer of similar type is manufactured by the Automatic Temperature Control Co.

ducer in the extensometer to satisfy these requirements.

Electrical Circuit

The basic functions of the electrical circuit, Fig. 3, are to amplify, rectify, and record the signal from the microformer. In addition, means are provided for electrical and mechanical calibration, change of magnification, and suppression of the recorder zero.

Alternating current from a regulated source of good wave form is fed through a variable autotransformer to a stepdown transformer that excites both the primary winding of the microformer on the extensometer arms and a second or calibrating microformer. The output of both microformers, in series, goes to the input of an a-c vacuum tube voltmeter.[3] In the vacuum tube voltmeter (VTVM), the signal is amplified and rectified. The amplification may be changed with the VTVM scale selector switch. The rectified output of the VTVM supplies a d-c voltage to a strip chart or *x-y* recorder. Inserted in the d-c circuit between the VTVM and recorder is a zero suppression circuit that is capable of bucking out any desired d-c voltage or suppressing the recorder zero in increments equal to the full scale reading (≈10 mv). The zero suppression circuit is made up of precision, wire-wound, fixed resistors, and 10-turn variable resistors.

A typical set of operating conditions with the extensometer at an initial magnification[4] of 1000 is as follows: autotransformer output, 40 v; stepdown transformer output, 2 v; vacuum tube voltmeter range, 0.1 v full scale; recorder range, 10 mv. Switching to the 1.0-v range on the VTVM changes the magnification to 100.

Circuit Functions

A regulated voltage source is required because the microformer output is directly proportional to input voltage. The variable autotransformer enables continuous adjustment to be made of the exciting voltage and thus the magnification, over about a four to one range. During a given series of tests, the autotransformer is not adjusted. It is used principally to secure fine adjustment of magnification during calibration.

The calibrating microformer serves two important functions: it permits calibration of the electrical circuitry at any time, and it is necessary for good accuracy at low strains with the circuit shown. The output voltage of a microformer is at a maximum at each end of its range; the output at the center of the range is zero. A phase reversal of the output occurs at the center of the range, making voltage readings single valued, in terms of displacement, if the phase is known. To utilize the full range, the extensometer microformer output must be relatively high (about 0.3 v) at zero strain. An extension of 0.001 in. (about 5 mv ac) would be difficult to resolve accurately at this high initial voltage output because the vacuum tube voltmeter stability is a few per cent of full scale on each range. The calibrating microformer is adjusted to buck out the extensometer microformer output at zero strain so that the VTVM operates on the small signal caused by specimen extension rather than the full initial extensometer output voltage. This permits the VTVM to be operated on a higher sensitivity (lower voltage) scale. The amplification and output to the recorder are thus greater and the VTVM error is less in terms of specimen extension.

The calibrating microformer may be adjusted with a micrometer screw and position changes read to 0.0001 in. with a dial gage of 0.2-in. range. When the extensometer microformer has been calibrated (with an extensometer checking device) against the calibrating microformer, any desired magnification of the extensometer can be calibrated on the recorder chart by using the calibrating microformer dial-gage readings and a correction factor obtained from the initial intercalibration of the microformers. A correction factor is not necessary if a matched pair of microformers is used.

The a-c vacuum tube voltmeter amplifies the microformer output signal. The ranges of the instrument are multiples of ten; hence magnification changes by factors of ten are obtained by rotating the range switch. Rectification is accomplished in the VTVM to provide a d-c voltage to the panel meter (a d-c instrument). This voltage, obtained from the terminals of the panel meter, feeds the recorder input through the zero suppression circuit.

The zero suppression circuit can subtract up to about 100 mv from the rectified output of the VTVM, but it serves two important functions in so doing. There is always a small residual voltage from the VTVM, which is bucked out by adjusting one of the 100-ohm variable resistors so that the recorder reads zero at zero extension. The residual voltage is not the same for each scale of the VTVM, so a separate 100-ohm variable resistor is supplied for each range with a selector switch (switch No. 2) to choose the proper correction voltage when the VTVM range is changed. The second function of the zero suppression circuit is to enable high magnification records to be continued after the recorder has reached full scale; switch No. 1 picks off successive increments of voltage, from the network of 1-ohm resistors, to suppress the recorder zero an amount equal to the full scale reading. The 200-ohm rheostat adjusts the voltage across the 1-ohm resistors.

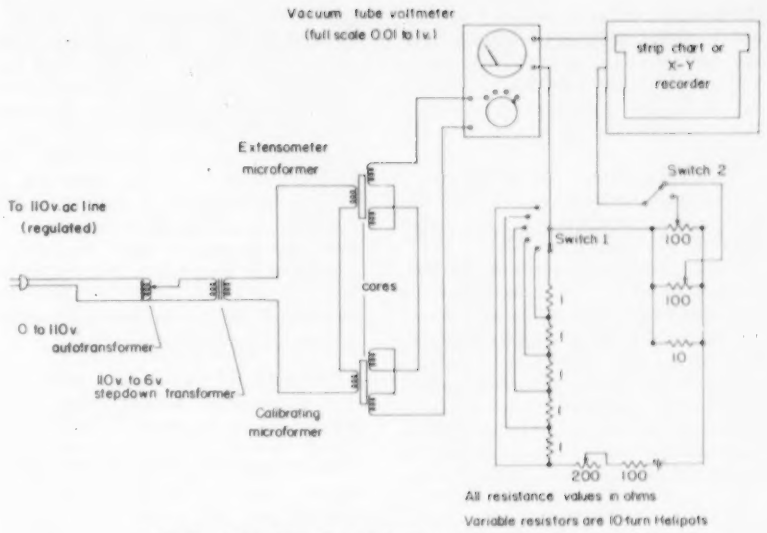

Fig. 3.—Circuit for Remotely Operated Extensometer.

Operation

A warm-up period of several minutes is required for stability. The current through the zero suppression circuit is adjusted so that moving switch No. 1 by one position will cause the recorder to travel from full scale to zero. Next,

[3] A Ballantine Model 302B having full scale ranges of 0.01 to 100-v ac was used.

[4] Throughout this paper, magnification refers to the ratio of chart indication to specimen extension.

the variable resistors, required to buck out the residual voltage from the VTVM, are adjusted for each VTVM scale. The magnification is checked by measuring the recorder travel in terms of motion of the calibrating microformer dial gage.

The extensometer is attached by actuating the rotation motor until the lever arm knife edges come in contact with the specimen.

Change of magnification during test, by factors of ten, is accomplished by changing the VTVM range switch and switch No. 2 to the corresponding position.

If it is desired to continue recording at the same magnification after the recorder has reached the upper end of the scale, switch No. 1 can be rotated to return the recorder pen to zero.

Discussion

Mechanical Design

The extensometer described was a pilot model that has proved satisfactory; no changes have yet been required, although certain improvements are obvious. The use of knife edges on pivoted arms sprung against the specimen appears to be practical; no slippage difficulties have been encountered even on metals harder than the knife edges. The force on each knife edge is well under 1 lb. Longer gage lengths and mechanical magnification by a factor of 3 or so can easily be incorporated without structural difficulties.

Use of the extensometer on round specimens of different diameters offers no difficulties. But the grips are depended upon to locate the specimen, with respect to the extensometer, so that the lever arm lengths are constant. Testing of sheet specimens has been successful in spite of the fact that the knife edges were brought to bear on the face rather than the edge of the specimens. For future use, it would be better to position the extensometer so that the knife edges bear on the specimen edges.

For precision work or tests on brittle materials, a group of three extensometers 120 deg apart would enable the alignment to be checked at low strains, and the electrical outputs could be summed, if desired, to make a true averaging type extensometer.

Electrical Circuit

The manner of handling the microformer output is somewhat unconventional. Usually, microformer recording is done with a null-balance circuit in which a servo motor drives a second microformer and some indicating or recording device. There are a number of mechanical and electronic difficulties associated with the null-balance system, particularly at small displacements.

All-electronic magnification, with the simple circuit illustrated, probably cannot compete in accuracy with a good null-balance system with mechanical magnification ahead of the microformer, but the all-electronic system has greater range. Although no attempt has been made to calibrate the extensometer to ASTM Method E 83,[5] it appears to be capable of meeting the class B requirements of that method without modification.

Of practical interest is the fact that the instrument will probably meet the class A requirements of Method E 83 over enough of the range to cover the 0.2 per cent offset for metals, although it may not be able to do so for ranges greater than 0.005 in. without considerable modification.

[5] Tentative Method of Verification and Classification of Extensometers (E 83 – 52 T), 1952 Book of ASTM Standards, Part 1, p. 1510; Part 2, p. 1286; Part 6, p. 1430.

Conclusion

An extensometer primarily developed to enable strain measurements to be made by remote control has been described. Several unique features are of potential value in conventional tension testing. The extensometer, mounted on a grip or crosshead, is always ready for use and may be applied to and removed from the specimen at any time during the test. It is adaptable to a variety of specimen shapes and sizes without modification. All strain magnification is obtained electronically, resulting in considerable flexibility of operation as regards magnification and range changes during the course of a test or before the start of a test. The extensometer also has a long range with high magnification.

A last factor, often important to the experimenter, is that the instrumentation can be assembled from readily available components.

Acknowledgment:

The assistance of the following persons is gratefully acknowledged: W. W. Davis for the electronic circuit; R. W. Hall (on loan from the National Advisory Committee for Aeronautics to Oak Ridge National Laboratory) for setup of the tension machine and initial testing; J. T. Gray for construction of the model; and W. E. Busby for the drawings in this report.

DISCUSSION

MR. B. L. LEWIS.[1]—The author has presented a very fine example of an extensometer required for determining the stress-strain relationship of radioactive specimens.

However, I feel that the extensometer with the knife edges on the side produced calibration errors due to changes in diameter and angularity due to change in length of the specimen during testing.

The latter error would not be so great on the sides of flat specimens, but is quite pronounced on the major dimensions. By placing the knife edges at 90 deg from their present location, as outlined in the paper, so they would be parallel to the axis of the pivoting point, some of these errors could be eliminated.

MESSRS. R. G. BERGGREN AND J. C. WILSON (*authors' closure*).—The authors would like to thank Mr. Lewis for his discussion of this paper. The errors due to changes in specimen diameter and lever arm angularity during testing are small.

The errors due to changes in diameter at small strains are negligible. Even if a $\frac{1}{4}$-in. diameter specimen experiences 75 per cent reduction of area before the onset of necking, the maximum error, at 75 per cent reduction of area, is only 0.05 per cent of the measured elongation and is correspondingly less at lower strains.

The nonlinearity due to change in the angularity of the lever arms during specimen elongations up to the full range of the transducer (0.120 in.) is a maximum of 0.2 per cent of the measured elongation and is proportionately less at smaller elongations. If the adjustable lever arm stop on the yoke is so far from proper adjustment as to drop the knife edges $\frac{1}{4}$ in. below the normal position, an extreme case, the nonlinearity will still be less than 1 per cent of the measured elongation. These small nonlinearities are determined by calibration of the extensometer when mounted on the testing machine.

When testing flat specimens, it would be desirable to mount the extensometer as outlined in the paper so that the knife edges bear on the edges of the specimen, thus reducing the possibility of slippage. Placing the knife edges so that they would be parallel to the axis of the pivoting point (parallel to the rotation axis of the lever arms) introduces difficulties in maintaining contact between the knife edges and specimen due to the arcuate motion of the lever arm ends during specimen elongation. The slight gain in accuracy has not been sufficient to justify this modification.

[1] Mechanical Engineer, Tinius Olsen Testing Machine Co., Willow Grove, Pa.

The Rapid Determination of Paper Moisture Contents

By J. J. Hamrick, Jr.

THE considerable variations in accounting machine card moisture contents caused by different amounts of machine processing and by different types of card storage conditions make it impossible to predict typical card moisture contents or ranges of moisture contents, even when the ambient conditions are known. The innumerable variations of climate further complicate predicting moisture contents, as the cards are only rarely at equilibrium. Therefore, direct measurements upon carefully selected cards in representative areas offer the only solution to this problem. Field investigations of moisture contents by the accepted methods of baking and weighing are undesirably slow and expensive for the size of sampling desired.

The problem of determining the typical card moisture contents when exposed to various high humidity conditions in business offices was resolved into the following phases:

1. Determination of the change in moisture content of accounting machine cards due to processing them through the machines.
2. Evaluation of the effect of different storage conditions upon the moisture content of the cards.
3. Selection and calibration of a suitable electronic instrument for moisture measurements.
4. Determination of the hysteresis loops for accounting machine cards at various temperatures.
5. Selection of representative areas of the country where the different types of high humidity operating conditions are encountered.
6. Field determination of accounting machine card moisture contents in the selected areas under various operating conditions.

Experimental Procedures and Test Results

Card Moisture Loss During Machine Processing

To determine the amount of moisture evaporated during consecutive processing through a series of business machines, one lot of cards with an original moisture content of 11.1 per cent was processed at 75 F and 75 per cent relative humidity in a manner simulating customer usage. The results, given in Table I, show that the moisture content at any particular time is affected by a rest period between processings. The cards are dried during actual processing, but during the rest period adsorption starts replacing the lost moisture to again reach equilibrium with the atmosphere. It follows that the moisture content of the cards is dependent not only upon the length of the rest periods between the several machine runs, but also upon whether or not the cards are protected from the prevailing atmosphere during these rest periods.

Environmental chambers will produce moisture content of accounting machine cards that are representative of high humidity conditions in business offices.

TABLE I.—MOISTURE LOSS OF A SINGLE LOT OF CARDS DURING CONSECUTIVE PROCESSING THROUGH FOUR TYPES OF ACCOUNTING MACHINES.

Machine Type	Original Card Moisture Content, per cent	Moisture Content of Cards After Processing, per cent	Moisture Loss During Processing, per cent
A...	11.1	10.0	1.1
B...	10.0	9.2	0.8
C...	9.2	8.0	1.2
(At this point, the cards rested for 18 hr in a wooden file drawer, and their moisture content increased to 8.7 per cent)			
D...	8.7	8.4	0.3
A...	8.4	8.1	0.3
B...	8.1	7.9	0.2

The four different machines dried the cards to different extents, depending upon (1) the amount of heat generated within a specific machine, and (2) the original moisture content of the cards.

Effect of Storage Conditions upon Cards

Cards were exposed to four different storage conditions: (*a*) individually in wire racks, (*b*) stacked in decks of 500 cards, (*c*) tightly packed in unsealed, corrugated cardboard cartons, and (*d*) tightly packed in wooden file drawers. The atmospheric conditions of exposure were changed every 20 hr in a manner to simulate certain observed conditions in the Gulf Area, similar to those shown in Fig. 1. All cards were first conditioned to equilibrium at approximately 4½ per cent moisture content, and were then given 20 hr exposure to the first test conditions. Moisture content of the protected cards lagged behind that of the exposed cards in attempting to reach equilibrium with the ambient conditions. During the last test conditions, the exposed cards were losing moisture to the atmosphere, but the protected cards were absorbing moisture as their moisture content was still below that of equilibrium.

Selection and Calibration of a Moisture Meter

Preliminary investigations disclosed that normal manufacturing variations of ±0.0002 in. in thicknesses of accounting machine cards caused too great a difference in calibration to employ electronic moisture meters based upon the measurement of capacitance. Attention was therefore directed toward moisture meters based on measuring electrical conductivity. In the instrument finally selected, the standard test

J. J. HAMRICK, Senior Test Engineer, IBM Corp., Endicott, N. Y., is in charge of Testing Laboratory research on effects of humidity on accounting machine card durability.

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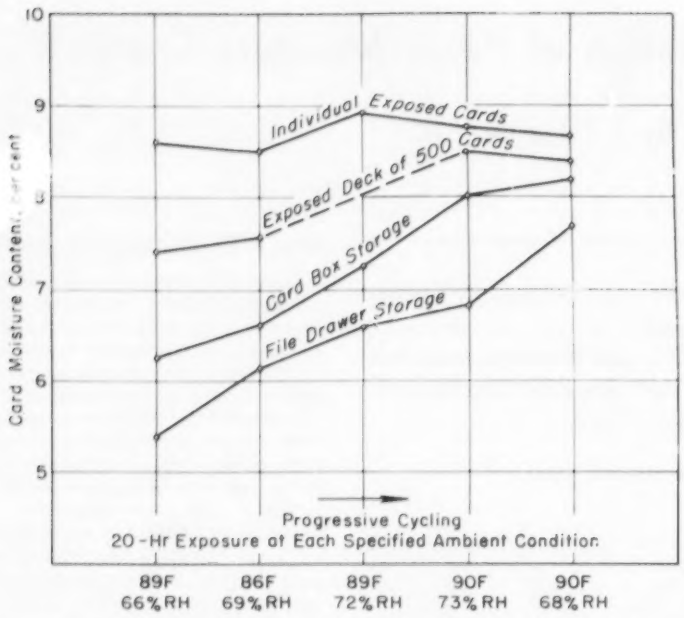


Fig. 1.—Moisture Content of Tabulating Cards. Atmospheric Conditions Simulating Those Reported from Gulf Area.

cell is designed so that the instrument reading is independent of thickness above a minimum thickness of 0.005 in. The Marconi Moisture Meter, type TF933, with compression cell TM4113 and electrode unit TM4178, was judged adequate for the type of measurements desired. In Fig. 2, this instrument is illustrated with an accounting machine card in the compression cell for measurement.

Test Procedure for Calibrating Moisture Meter

In order to determine the hysteresis loops of the cards at the same time that the instrument was calibrated, three temperature conditions (60, 73, and 90 F) and four relative humidity conditions (25, 50, 75, and 90 per cent) were used. The relative humidity was cycled at each of the test temperatures, a cycle consisting of increasing the relative humidity from the lowest to the highest test value and then decreasing it again to the original low humidity. Each combination of test conditions was maintained for at least 17 hr to permit the cards to come to equilibrium before the necessary measurements were taken.

A large environmental chamber was used to produce the different temperature and humidity conditions, and the ambient conditions were continuously recorded by a hygrothermograph which was calibrated against a precision sling psychrometer for each test condition. Control of the chamber was normally ±1 F and ±5 per cent relative humidity. The cards were in full equilibrium with the nominal test conditions except for a negligible amount of instability due to the up and down drift of the chamber as it cycled through its controlled operating range.

The Tappi[1] oven method was used for all accounting machine card moisture determinations. Each test sample consisted of ten cards, and all samples were run in triplicate. Two moisture meter readings were taken on each card. Thus, each determination consisted of the mean of 60 moisture meter readings.

Results of Moisture Meter Calibration

The test results showed each calibration to consist of two straight lines with different slopes; the point of intersection of the two lines varied with cards supplied by different manufacturers. The slopes of the segments of the lines determined for each sample were averaged and plotted as the calibration line for each temperature. The majority of the test determinations were within ±0.1 per cent card moisture of their respective calibration lines, and all of the determinations were within ±0.25 per cent card moisture of their respective lines. The moisture meter calibration for card manufacturer *A* is illustrated in Fig. 3.

The maximum spread of the 20 readings taken on each sample of ten cards ran as high as $5\frac{1}{2}$ (that is, it varied between 30 and $35\frac{1}{2}$) in two cases, but it usually varied between 2 and 3. In a number of cases, the spread was only 1 or $1\frac{1}{2}$. This spread is a result of slight variations in the cards themselves, plus the nearness of the cards to absolute equilibrium at the time the readings were taken.

To evaluate the effect of normal variations in the chloride content of the cards upon the moisture meter determinations, one sample of ten cards from each of seven different days' production

Fig. 2.—Marconi Moisture Meter, Type TF933, with Compression Cell TM4113 and Electrode Unit TM4178.

[1] Technical Association of the Pulp and Paper Industry Standards *T402m* and *T412m-42*.

was compared with the calibration test cards from this same manufacturer. The moisture meter readings for these production samples varied from −1 to +2 (and averaged +1) about the calibration cards. Such variations would affect the accuracy of moisture determinations only about ±0.1 per cent.

From the calibration data, it was possible to manufacture slide-rule type scales for use on the moisture meter. Including all the variables, card moisture may be determined within ±½ per cent by use of the meter with these scales.

Limitations of the Moisture Meter

Leisurely measurements may be made if the test samples are near equilibrium with ambient conditions; otherwise, it is necessary to make determinations with sufficient rapidity so that no significant change in the moisture content of the card surfaces can occur.

If the same card is checked repeatedly, the instrument reading will vary only slightly; this is also true if several cards are checked that have identical moisture contents. However, if several cards which have been exposed to the same atmospheric conditions are tested, the moisture meter readings will vary a little due to actual small differences in the moisture or ionic content of the cards.

At least two readings should be taken on each card and these should agree within one dial unit. Ten cards should be considered a minimum sample for an accuracy of ±½ per cent moisture content; 20 or more cards should be used when greater accuracy is desired.

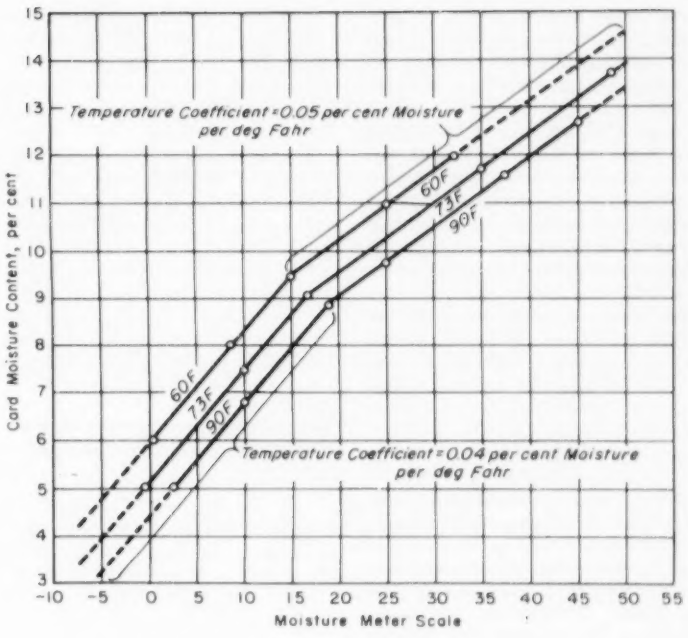
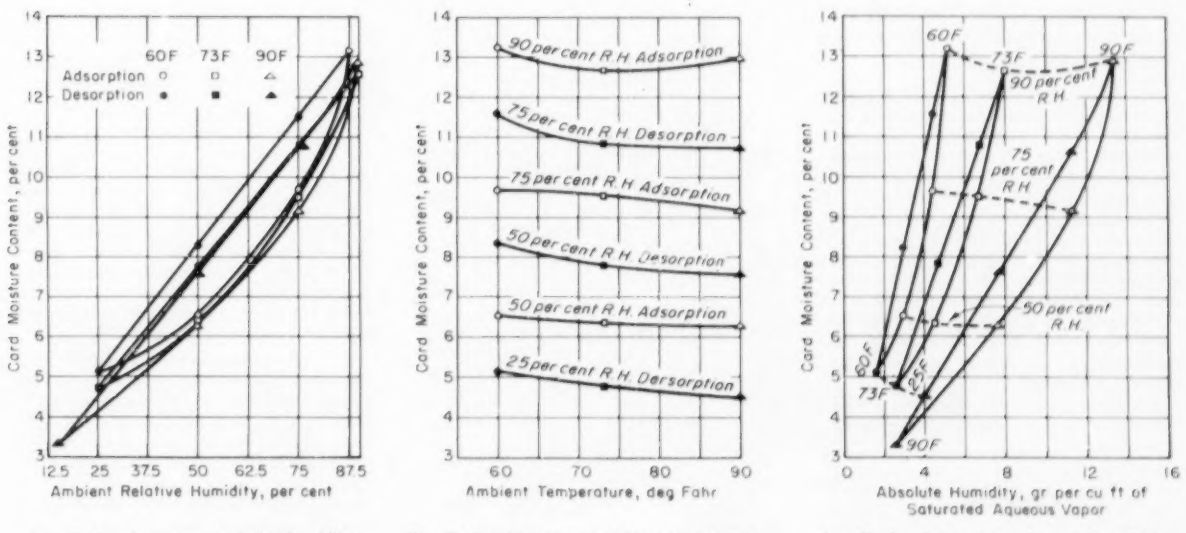

Temperature Coefficient = 0.05 per cent Moisture per deg Fahr
Temperature Coefficient = 0.04 per cent Moisture per deg Fahr
60F
73F
90F
Card Moisture Content, per cent
Moisture Meter Scale

Fig. 3.—Moisture Meter Calibration—Manufacturer *A*.

In all cases, the moisture meter—particularly the cell—must be near equilibrium with the ambient conditions. For practical purposes, 5 per cent moisture content must be considered the minimum limit for the moisture meter, although readings as low as 4 to 4½ per cent may be obtained in some cases with extra care.

Moisture Content of Card Stock Under Various Ambient Conditions

Accounting machine cards from three different paper manufacturers were used for the determination of hysteresis loops of adsorption and desorption at different temperatures. The data secured from the cards of manufacturer *A* are presented graphically in Fig. 4 showing (*a*


60F 73F 90F
Adsorption
Desorption
Card Moisture Content, per cent
Ambient Relative Humidity, per cent
90 per cent R.H. Adsorption
75 per cent R.H. Desorption
75 per cent R.H. Adsorption
50 per cent R.H. Desorption
50 per cent R.H. Adsorption
25 per cent R.H. Dersorption
Ambient Temperature, deg Fahr
90 per cent R.H.
75 per cent R.H.
50 per cent R.H.
Absolute Humidity, gr per cu ft of Saturated Aqueous Vapor

(*a*) Card moisture versus relative humidity. (*b*) Card moisture versus ambient temperature. (*c*) Card moisture versus absolute humidity.

Fig. 4.—Card Moisture Variations—Manufacturer *A*.

card moisture content *versus* relative humidity, (*b*) card moisture content *versus* ambient temperature, and (*c*) card moisture content *versus* absolute humidity.

In Fig. 4(*a*) are three typical hysteresis loops for adsorption and desorption; these show that at a specified relative humidity the moisture content of accounting machine cards depends more upon the direction of approach to equilibrium conditions than any other factor.

The effects of temperature on the moisture content of cards at various relative humidities are shown in Fig. 4(*b*). This effect is due to the fact that the vapor pressure in cards is a function of the card temperature.

Figure 4(*c*) illustrates that at a constant absolute humidity the moisture content of cards at equilibrium decreases with increasing temperatures.

All of the data in Fig. 4 are from cards of one manufacturer. Cards of other manufacturers that were within the same paper specification tolerances showed moisture contents that differed by as much as $\frac{1}{4}$ per cent at 25 per cent relative humidity and $\frac{1}{2}$ per cent at 75 to 90 per cent relative humidity. Therefore, caution must be exercised in applying these data to cards manufactured according to other paper specifications.

Selection of Representative Test Areas

In order to select test areas which offered atmospheric conditions representative of the various high humidity operating conditions, conferences were held with the staff of the U. S. Department of Commerce Weather Records Center in Asheville. Studies of the published data[2] of the Weather Bureau enabled representative test areas to be selected as follows:

1. Areas that have rapidly changing humidity with occasional periods of consistently high humidity. Most large metropolitan centers such as Washington, Pittsburgh, Cincinnati, or Chicago fit into this classification. Washington was selected for investigation as detailed data are more readily obtainable for it than any other suitable area. Figure 5 is a graphical presentation of the average daily temperatures and humidities for Washington in August. The bimodal curve illustrated is typical of daily temperatures and humidities unless affected by local conditions.

2. Areas that have consistently high humidities with occasional fluctuations.

[2] The Climate Handbook for Washington, D. C., Local Climatological Summaries for New Orleans, Local Climatological Summaries for Balboa Heights, Average Monthly Relative Humidities for 118 U. S. Cities, and Monthly Graphic Record of Washington, D. C., Weather.

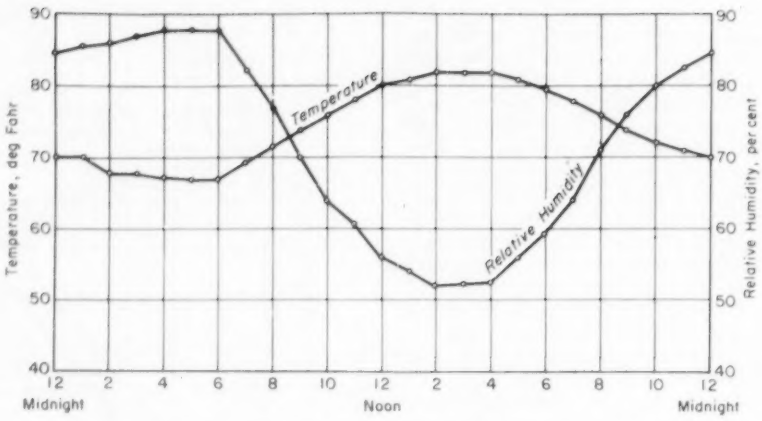


Fig. 5.—Daily Chart of Temperature and Relative Humidity. Average August Values, Washington, D. C.

TABLE II.—DAILY CHART OF SELECTED HIGH HUMIDITY DAYS IN NEW ORLEANS FOR THE MONTH OF JANUARY.

6 a.m.		Noon		6 p.m.	
Temperature, deg Fahr	Relative Humidity, per cent	Temperature, deg Fahr	Relative Humidity, per cent	Temperature, deg Fahr	Relative Humidity, per cent
70	89	76	81	72	86
70	92	76	80	73	99
67	97	76	72	70	93
67	94	77	66	71	85
71	90	75	79	72	87
69	94	76	73	72	86

TABLE III.—DAILY CHART OF SELECTED HIGH HUMIDITY DAYS IN NEW ORLEANS FOR THE MONTH OF JULY.

6 a.m.		Noon		6 p.m.	
Temperature, deg Fahr	Relative Humidity, per cent	Temperature, deg Fahr	Relative Humidity, per cent	Temperature, deg Fahr	Relative Humidity, per cent
76	91	81	79	83	73
76	92	84	77	81	76
78	89	82	74	77	88
73	95	75	93	74	91
79	85	82	86	75	90

TABLE IV.—DAILY CHART OF TEMPERATURE AND HUMIDITY FOR BALBOA HEIGHTS.

	6 a.m.	Noon	2 p. m.
Dry Season:			
Temperature, deg Fahr	72.5	87.0	87.9
Relative humidity, per cent	91.5	58.9	55.3
Rainy Season:			
Temperature, deg Fahr	73.9	84.2	83.8
Relative humidity, per cent	94.4	74.4	74.0
Yearly Mean:			
Temperature, deg Fahr	73.5	85.1	85.2
Relative humidity, per cent	93.4	69.2	67.8

New Orleans, which has semitropical weather, was selected as being representative of these areas, such as the region bordering on the Gulf and the major portion of the West Coast. Typical "warm spell" winter weather daily temperatures and humidities are given in Table II. Table III shows typical daily high humidities for the summer month of July.

3. Balboa Heights in the Canal Zone was selected to represent those areas consistently subjected to very high humidities. Some offices with air conditioning have been unable to reduce the relative humidity below 75 per cent. Table IV illustrates the daily temperatures and humidities for Balboa Heights and shows a normal dry season variation of relative humidity from 55 to 91 per cent and a rainy season variation from 74 to 94 per cent.

Conclusions

Studies of weather history have shown that during certain periods of the year, Washington, D. C., New Orleans, La., and Balboa Heights, Canal Zone, experience weather representative of the various types of high humidity operating conditions found in accounting machine installations.

In order to find the maximum moisture content of the cards under specified high humidity conditions, sampling must be limited to cards which have not been processed through machines recently, and to cards which are exposed individually or in small groups to the ambient conditions. Time card racks and tub files are examples of this kind of exposure.

An electrical moisture meter which will enable direct measurement of the card moisture content has been calibrated. The accuracy of the meter for ordinary determinations is within $\pm\frac{1}{2}$ per cent moisture content, but whenever greater accuracy is desired, calibration for specific card samples will give accuracies exceeding $\pm\frac{1}{4}$ per cent moisture content.

Measurements of the moisture contents of accounting machine cards are now in progress in the selected localities, and the data obtained will permit the operation of environmental chambers with ambient conditions that will produce moisture contents truly representative of high humidity operating conditions in business offices.

Determination of the hysteresis loops of adsorption and desorption has enabled the presetting of environmental chamber ambient conditions to produce desired moisture contents without the necessity for continually determining moisture contents and adjusting the ambient conditions until the desired moisture content is reached.

Sealability of Gasketing Materials on Smooth and Wavy Flanges

By F. C. Thorn[1]

In view of the present interest in conformity or "sealability" as a fundamental property of commercial gasketing, it was felt that some interest might be shown in the test procedure that has been employed in the author's laboratory for the past several years. The use of this device originated as a result of the appointment of a Task Force within the ASME Boiler Code Committee to explore fundamental gasket constants with a view to an ultimate revision of the present Unfired Pressure Vessel Code. The determination of sealability was the assignment of the writer.

The apparatus is shown in Fig. 1. It differs only in detail from that employed by the British Institution of Mechanical Engineers,[2] the Material Testing Department of the Technological Institute, Stuttgart,[3] and possibly that of other investigators with whose work the author is not familiar. Basically any sealability test involves a pair of platens, facilities for putting these under load, for introducing the fluid medium into the interior, and for measuring the leakage. It is necessary at the outset to make the following decisions:

(*a*) Should the load be predetermined and fixed during the test? In the author's opinion a load which changed during the test as a result of relaxation would introduce too many variables; therefore, a constant compression method was selected. The apparatus shown in Fig. 1 employs this method and is designed to be held in a Baldwin Southwark heavy-duty compression machine equipped with a stress holder.

(*b*) What temperature to employ?

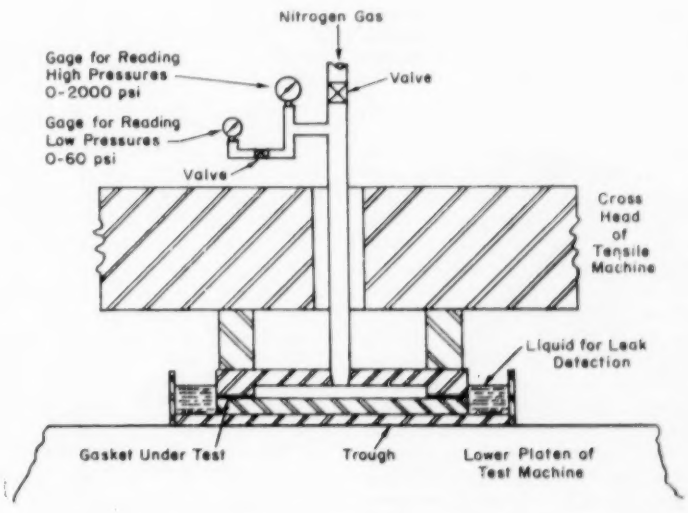


Fig. 1.—Schematic of Gasket Test Apparatus.

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[1] Research Director, The Garlock Packing Co., Palmyra, N. Y.

[2] First Report of the Pipe Flanges Research Committee, British Institution of Mechanical Engineers, Feb., 1936, London.

[3] E. Siebel, "Versuche über das Verhalten von Dichtungen," *Forschung*, Vol. 5, No. 6, pp. 298-305 (1934).

Room temperature was selected since all gaskets start service at this temperature.

(*c*) What medium to employ? Bottled nitrogen was chosen because gas leakage is immediately evident and lends itself readily to measurement. It is recognized, however, that gas is more difficult to pack than water or oil, and results must be interpreted accordingly.

(*d*) What loading period before introducing gas? Although it is recognized that sealability is often improved by a loading period, these tests were carried out without a loading period.

(*e*) What means of measurement to employ? Gas leakage can be estimated by a chemical detector, as in Freon, or by collecting the escaped gas, or by noting the pressure drop in a confined space. The latter method was used.

(*f*) What surface to employ? Commercially ground steel plates were used. Although the profilometer value was not determined, the scratch pattern is clearly visible and crosses the gasket. Concentrically-grooved and spirally-grooved (phonograph) flanges were used in the investigation but results are not included. A plate with a sine-wave section was developed which is used to replace one of the smooth plates, and some values obtained with this wavy plate are shown in Table I. A profile of the wavy flange is shown in Fig. 2.

(*g*) How to express results? The m value, which is the ratio of residual unit load to fluid pressure at leak, is favored. Residual unit load is initial unit load minus the fluid relief which is the unit load necessary to support the joint against blowing apart. Fluid relief is defined as the gas pressure at leak times the inside area, divided by the net area. The m value computed in this manner has been designated m_1 and is identical with c_3 of the British Institution. Other workers, notably those in the Boiler Code Committee, have assumed that fluid pressure is operative over a greater area than that of the inside of the gasket, and that there is an unequal distribution of the residual load over the net gasket area. The m values computed from these assumptions are naturally unlike, a fact which must be borne in mind in comparing data from different sources.

The apparatus takes a $4\frac{3}{8}$ by $6\frac{1}{8}$ by $\frac{1}{16}$-in. gasket and corresponds to a 4-in. 400 series raised face joint. After load is applied, the gas pressure is introduced by steps—up to 50 psi by tens; 50 to 100 psi by twenty-fives; 100 to 300 psi by fifties; and 300 psi to failure by hundreds; and held for 5 min at each step. Failure is defined as a loss of 10 psi pressure within the locked-in gas volume during this time. Since the confined volume is approximately 6 cu in., this works out to 1 cu cm per min per in. of inside circumference. A lower rate is difficult to read. The reported leakage point is midway between the first "leak" reading and the last "no leak" reading. The oil trough gives qualitative information to supplement the pressure reading. A failure as defined above is associated with active foaming in the oil trough.

The "m_1" values when plotted against initial load take the form of a curve approaching unity as a theoretical limit. Values below unity are obtained when the gasket sticks to the flange.

Results on typical gasketings are shown in Table I.

With reference to Table I, it can be seen that the results on the red sheet were almost as good using the wavy plate as they were with the smooth plates. This is interesting, particularly in view of the fact that the depth of the valleys in the wavy plate is 20 per cent of the gasket thickness. The abnormally low value of m_1 on smooth plates at 2000 psi is clearly the result of adhesion as shown by the character of the failure.

Fig. 2.—Section of Test Chamber Showing Wavy-Flange Profile.

TABLE I.—RESULTS OF TESTS ON GASKET MATERIALS.

Material	Flange	Initial Load, psi	Gas Pressure, psi	Residual Load, psi	m_1
$\frac{1}{8}$-in. red sheet[a]	Smooth	500	125	370	2.9
		1000	450	530	1.2
		2000	1350	597	0.4[b]
	Wavy	500	<5	>495	Infinite
		1000	350	642	1.8
		2000	>1000	<960	0.9
$\frac{1}{8}$-in. cork paper, glue-glycerine binder	Smooth	500	225	266	1.2
		1000	350	635	1.87
		2000	950	1110	1.2
	Wavy	500	62	435	7.0
		1000	112	881	9.0
		2000	112	1881	17.3
$\frac{1}{8}$-in. compressed asbestos sheet	Smooth	500	125	370	3.1
		1000	225	766	3.4
		2000	450	1532	3.4
		5000	1850	3070	1.7
	Wavy	500	<5	500	Infinite
		1000	25	975	39
		2000	45	1953	44
		5000	87	4910	57

[a] Conforms to ASTM Tentative Specification for Sheet Rubber Packing (D 1330), 1955 Book of ASTM Standards, Part 6.

[b] Gasket blew out disruptively.

In contrast to the result on the red sheet, those on the cork paper with glue-glycerine binder indicated that, although the sealability was excellent on smooth plates, it was much poorer on wavy plates than would be predicted on the basis of the compressibility of the material. This indicates that not only is compressibility important, but the ability of the material to flow from high points to low points is also important. This is a property exhibited in the highest degree by rubber but not in general by paper.

The bottom section of the table shows results on compressed asbestos sheet using both smooth and wavy plates. As would be expected, this material, although showing fair sealability on smooth flanges, is exceedingly poor on wavy flanges.

It is obvious that much more work toward perfecting this test is desirable; innumerable variations such as specimen size, flange finish, temperature, loading ability, leakage criteria, etc., should be investigated. The work to date does indicate that the sealability test at the present state of development is a useful tool both for the gasket manufacturer and the gasket user.

Development of a Method for Determining the Oil Separation Tendencies of Multipurpose Greases

By S. Fred Calhoun

Of two methods of determining the bleeding tendencies of greases, the air pressure method exhibits a higher value and wider spread in results, has good repeatability, and is reliable.

It is generally known that greases, especially the softer ones, tend to separate oil (bleed) in static storage over a period of time. This tendency seems to be quite variable among the products of different manufacturers. The effect of oil separation upon the lubricating qualities of a grease is a matter which is as yet undetermined. A number of field tests made on the all-purpose greases secured under Specification MIL-G-10924 has shown them to give good performance irrespective of the extent of oil separation during static storage. In one test in particular, two greases were selected. One had shown "excessive" bleeding during static storage, whereas the other exhibited little or no bleeding under the same conditions. The results observed at the conclusion of the test were inconclusive. Both seemed equally effective as far as lubrication was concerned. The "bleeder" softened to a greater extent in use and seemed to give better protection against fretting corrosion than the "nonbleeder." Whether this was due to the bleeding or to some other factor, such as additives or consistency, was not determined.

The multipurpose greases purchased by the Ordnance Department under Specification MIL-G-10924 have given excellent over-all performance in use. The products secured from two or three manufacturers did, however, exhibit a tendency to separate oil in what was believed to be excessive amounts during static storage in the original containers or in vehicles. Mechanics and other field personnel were concerned over this oil separation and were inclined to discard a profusely bleeding grease as unfit for use. In several installations oil dripping from the grease-packed constant velocity joints of stored vehicles caused deterioration of a large number of tires.

The test for oil separation incorporated in Amendment 1 of MIL-G-10924, a modified cone method, did not show a difference between the greases that bled profusely and those that showed little or no bleeding great enough to be used as a basis for distinguishing between them. The Rock Island Arsenal laboratory was requested to devise a test to show as great a difference as possible between the greases in regard to oil separation tendencies. The test was to be for static storage conditions only since there was little or no complaint of oil separation from vehicles in use. The constant working of the grease in an active vehicle either prevented oil separation or remixed the components so that no separation was evident.

Several methods of testing this bleeding tendency have been developed and used during the past two decades. Herschel (1)[1] developed a test in which grease was placed between blotting and filter paper and the whole subjected to pressure. The loss of weight of the sandwich was reported as the separation. Roehner and Robinson (2) placed the grease in a Büchner funnel fitted with a fritted glass filter. Air pressure applied to the funnel forced oil through the filter, and this was reported as the separation. Farrington and Humphreys (3) filled a 6-in. funnel with grease and extended a wire gauze cylinder up into the grease through the stem. Milberger and Swatik (4) collected the oil in a 6-in. cone, made in the surface of 25 lb of grease in a pail, and pipetted it out to determine oil separation.

The Coordinating Research Council (5) issued a report in 1947 covering their study of five methods of testing oil separation. The methods studied by this group were:

1. Centrifuge oil separation test.—The sample is centrifuged for 24 hr at 2600 rpm and the supernatant oil determined.

2. Modified AN-G-3a method.[2]—Ten grams of grease in a 60-mesh wire screen cone are maintained at 150 F for 100 hr. The separated oil is collected in a beaker and its weight determined.

3. Basket bleeding test.—This is the same as the modified AN-G-3a method, except that a cylindrical gauze basket is substituted for the cone.

4. Truncated cone procedure.—The grease is smeared evenly around the inside of a truncated glass cone. After 168 hr at 150 F, the separated oil collected in the supporting beaker is weighed.

5. Bulk storage test.—A 1-lb sample is stored for 3 months at 120 F. The amount of oil collecting in a triangular trough cut in the surface is decanted and weighed.

From the results obtained by several laboratories in the above tests, it was concluded that none of them was suitable for all types of greases. Because of these findings and also the desire to shorten the time of the test and to secure a larger spread in results, some different approaches to this study were considered desirable.

Test-Tube Test

Since grease is usually stored in containers of assorted sizes and the oil collects in holes or cavities in the grease, several attempts were made to devise a test based on this fact. Attempts to get the oil out of these cavities on anything like a quantitative basis

S. FRED CALHOUN, Chemist, Petroleum Products Section, Rock Island Arsenal, Rock Island, Ill., has since 1952 been doing research work on all-purpose greases. Previous to this time he has done research work on fatty acids, oxidation of aryl hydrocarbons, and has been engaged in teaching.

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[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

[2] Army-Navy Aeronautical Specification—Grease: Low Temperature Lubricating.

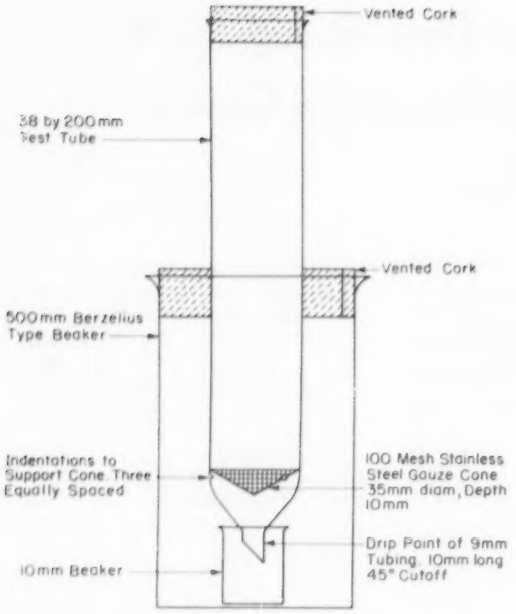
Vented Cork
38 by 200mm Test Tube
Vented Cork
500mm Berzelius Type Beaker
Indentations to Support Cone Three Equally Spaced
100 Mesh Stainless Steel Gauze Cone 35mm diam, Depth 10mm
Drip Point of 9mm Tubing, 10mm long 45° Cutoff
10mm Beaker

Fig. 1.—Details of the Test-Tube-Type Apparatus.

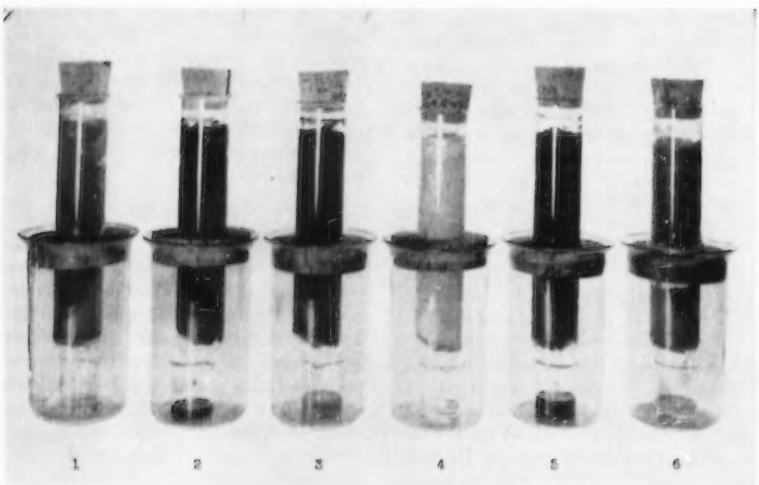

Fig. 2.—Test in Progress in Test-Tube Apparatus.

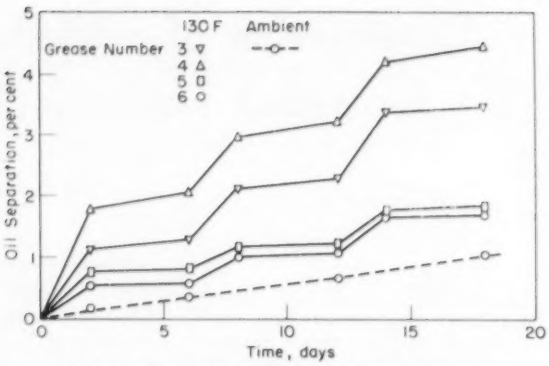

Fig. 3.—Effect of Cycling upon Oil Separation.
Cycle: 2 days at 130 F; 4 days ambient.

were unsuccessful so this approach was abandoned. A method was eventually developed to simulate storage conditions and to drain the oil from the bottom of a large test tube. The apparatus developed for this procedure is shown in Fig. 1. Figure 2 shows a group of six greases during the progress of a test.

In practice the apparatus was cleaned with a suitable solvent and assembled. The test tube, with the gauze cone in place, was counterbalanced and 130 ± 0.1 g of grease added. After trying several methods of filling the test tube with grease, it was found best to add it in small amounts with a suitable size spatula and tap gently to settle it.

Since stored grease would be subject to a cycling action, consisting of alternate periods of low and high temperatures, the first tests were made under such conditions. Figure 3 shows graphically the results of one cycle-sequence upon four greases. The sequence used was two days at 130 F, followed by four days at room temperature; this was then repeated. As is shown in Fig. 3, the rate of oil separation during the time at room temperature was negligible. The temperature of 130 F was used because it was the reported high temperature in some storage depots. One of the greases was left at ambient temperature during the time of the test, and the results obtained from this grease are indicated by the dotted line.

The same greases were then kept at 130 F in a mechanical convection oven for a similar period of time. The results obtained are shown in Fig. 4 together with the results for one of the greases kept at ambient temperature. A comparison of these figures reveals that the continuous elevated temperature gives higher values in a shorter time. Consequently this method was adopted and used to obtain the results which follow.

The temperature selected was 130 F for the reason given above, and the test was made on 49 different greases from 16 manufacturers. Different batches of the same type of grease were treated as different greases since they were often found to vary considerably in their bleeding rates. The results of a number of tests on each of six randomly selected greases are given in Table I, together with the mean and maximum deviation from the mean, both in absolute values and as per cent of the mean. From these results the accuracy of the test is seen to be good: the results of a number of tests on a grease generally did not vary more than 7 per cent from the mean. Standard deviations are also given for comparison.

The first tests were run for a number of days in order to get a picture of the longer range results. Figure 5 shows the results obtained for a 14-day period and is typical of the results obtained for all greases tested. It can be seen that the bleeding rate is greatest during the first three or four days, after which it begins to level off. Since the relative bleeding rate is evident after about three

days, it is unnecessary to continue the test beyond this period to secure the desired information.

Pressure Test

The test-tube tester as described, although it gave good repeatability and correlated well with field observations, was felt to require too long a time and failed to give the desired spread in results. Work was therefore directed to eliminating as far as possible these objections by using pressure in addition to heat in the running of the tests. At first the pressure was produced by placing disks of steel upon the surface of the grease in the test tube. Tests were also run at 160 F with and without the addition of weights. The results obtained by this method are shown in Table II. This table contains a random selection of six greases from the many that were tested. Although the use of heat and pressure gave a higher per-

TABLE I.—BLEEDING PERCENTAGES USING TEST-TUBE TESTER.

Time—72 hr; temperature—130 F.

Grease	Individual Results, per cent					Mean	Maximum Deviation from Mean	Maximum Deviation, per cent of Mean	Standard Deviation, σ
	Test No. 1	Test No. 2	Test No. 3	Test No. 4	Test No. 5				
No. 10	1.98	2.15	2.28	2.20	...	2.15	0.17	7.9	0.127
No. 14	2.16	1.98	2.02	...	...	2.05	0.11	5.3	0.029
No. 21	1.65	1.63	1.67	...	...	1.63	0.02	1.2	0.032
No. 24	1.32	1.24	1.27	1.29	...	1.28	0.04	3.2	0.033
No. 26	1.45	1.43	1.41	1.53	...	1.46	0.07	4.8	0.053
No. 27	1.49	1.65	1.50	1.52	1.59	1.55	0.10	6.45	0.068

TABLE II.—COMPARISON OF BLEEDING PERCENTAGES FOR A 24-HR PERIOD.

Grease	Test-Tube Tester				Pressure Tester
	130 F	130 F + 40 g	160 F	160 F + 40 g	0.35 psi, Temperature Ambient
No. 1	0.73	1.02	1.04	1.38	6.82
No. 6	0.85	0.95	0.98	1.10	5.93
No. 8	0.64	0.78	0.92	0.82	7.48
No. 11	0.87	1.48	1.61	1.73	12.55
No. 15	1.50	1.74	2.11	2.11	19.08
No. 18	0.65	0.86	1.09	1.41	5.52

TABLE III.—BLEEDING RATES OBTAINED WITH PRESSURE-TYPE TESTER.

Time—24 hr; pressure—0.35 psi; temperature—77 ± 2 F.

Grease	Individual Test Results, per cent						Mean	Maximum Deviation from Mean	Maximum Deviation, per cent of Mean	Standard Deviation, σ
	Test No. 1	Test No. 2	Test No. 3	Test No. 4	Test No. 5	Test No. 6				
No. 3	11.30	11.10	12.36	11.60	11.15	11.22	11.59	0.77	6.65	0.44
No. 4	6.24	6.32	6.78	6.80	6.80	6.68	6.60	0.36	5.47	0.23
No. 7	8.26	8.37	8.10	8.02	...	...	8.19	0.18	2.20	0.16
No. 12	5.04	5.20	4.92	5.22	...	...	5.09	0.17	3.34	0.14
No. 13	17.15	17.20	17.30	17.46	...	...	17.28	0.18	1.04	0.13
No. 14	5.80	5.65	6.11	5.78	...	...	5.84	0.27	4.63	0.19
No. 16	11.08	11.40	10.70	10.65	10.74	10.94	10.92	0.48	4.39	0.29
No. 17	10.55	10.20	9.80	9.82	10.10	10.27	10.12	0.43	4.25	0.28

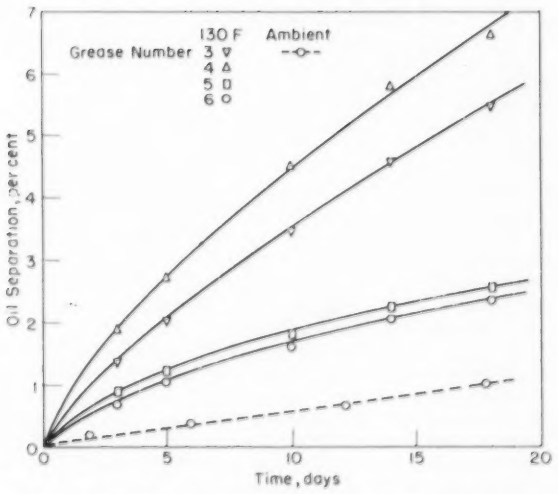

Fig. 4.—Effect of Continuous Heat upon Oil Separation.

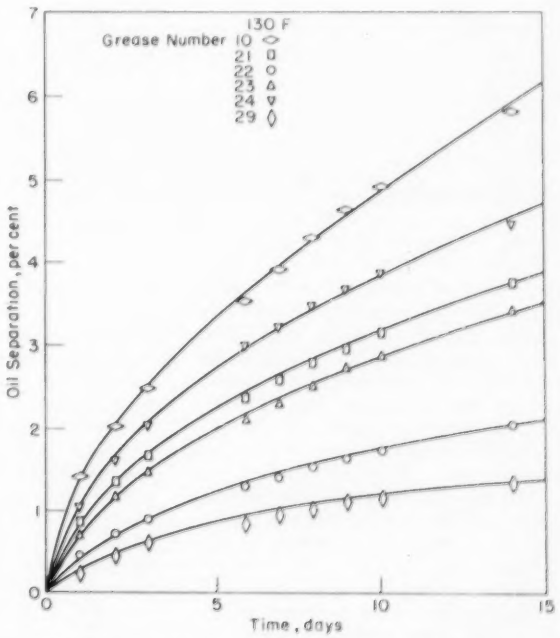

Fig. 5.—General Shape of the Oil Separation Curves.

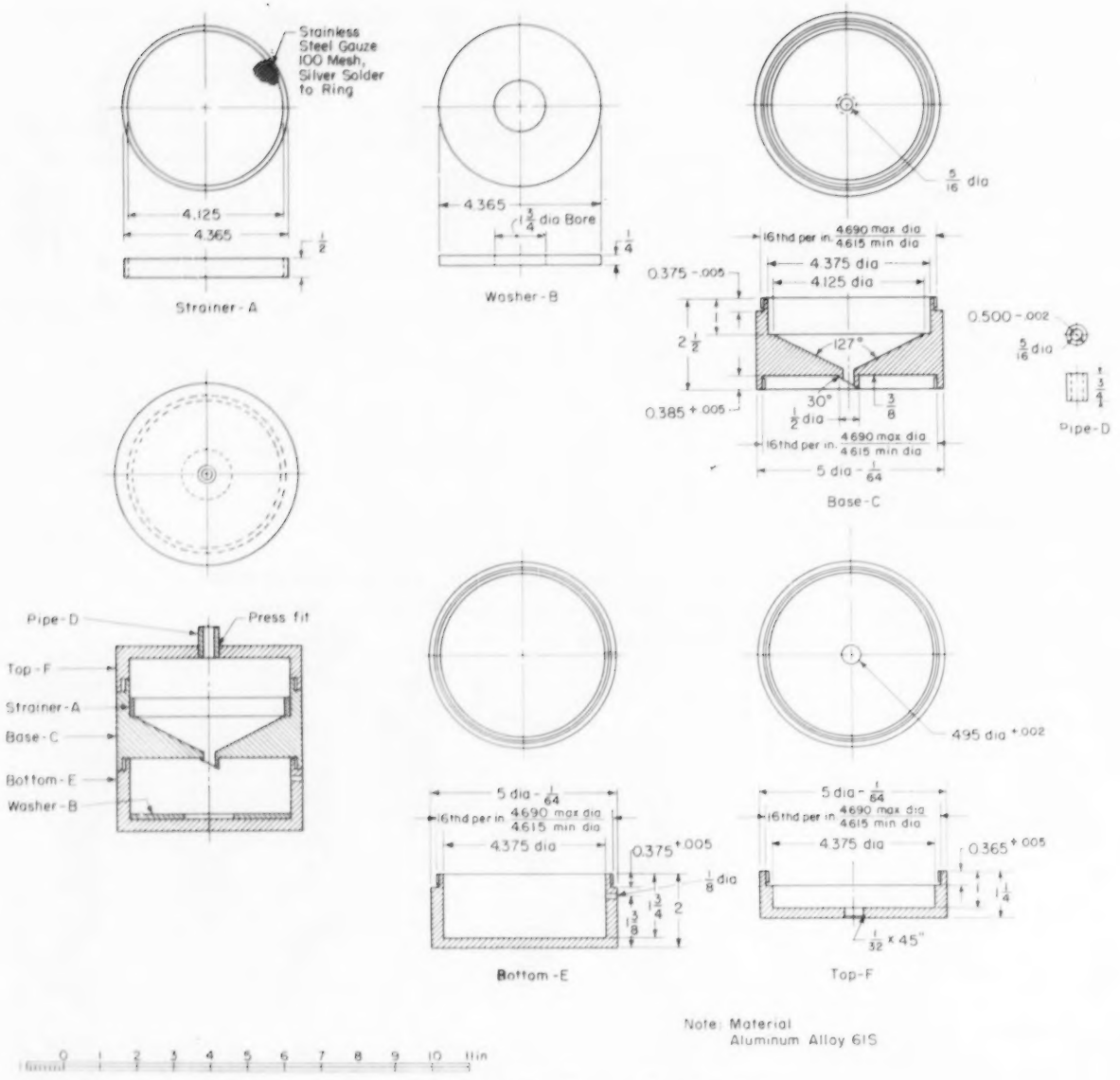

Fig. 6.—Details of the Air-Pressure-Type Apparatus.

centage of oil separation, a fairly long time was still required to secure the spread desired. Also at the higher temperature and pressures, considerable bleeding occurred at the top of the grease around the weights. This oil could not be completely poured off and consequently introduced an error that was undesirable.

The use of air pressure has been reported previously (2). Since the completion of the major portion of the present work, a report on the use of a vacuum to draw the oil out has been published (6). After a period of development, the apparatus shown in Fig. 6 was found to give satisfactory results using air pressure. The apparatus holds 130 ± 4 g of grease, weighed to ±0.5 g; this is supported on a 100-mesh stainless steel gauze which in turn is soldered to a brass ring to hold it taut. Pressure is applied to the surface of the grease by connecting pipe *D* to a source of air pressure by means of a rubber hose. The air supply system should be capable of close pressure control since pressures in excess of 0.35 psi are sufficient to force some greases through the gauze. A reducing valve in series with a Cartesian Manostat was found to give very good control. A mercury manometer and a release valve to protect against surges were added. The complete assembly accommodating six testers is shown in Fig. 7. The separated oil is collected in a 20-ml beaker and its weight determined to the nearest centigram. Figure 8 shows the apparatus disassembled and displays the parts in relation to each other. All parts are machined from aluminum except for the stainless steel gauze and its supporting brass ring.

In column 6 of Table II are given the results obtained on six greases with the air-pressure-type apparatus, the other columns showing the results of variations in the test-tube method on these same greases. The results indicate that the air-pressure method gives the

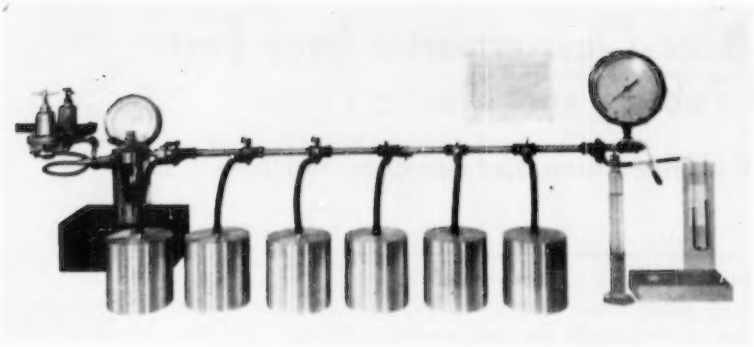

Fig. 7.—Assembled Air-Pressure Apparatus During a Test.

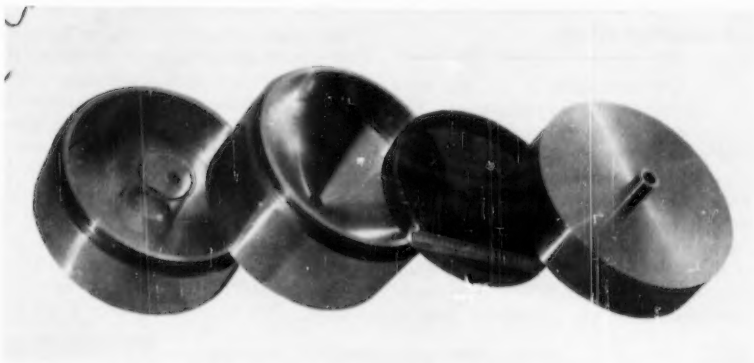

Fig. 8.—Top View of Disassembled Air-Pressure Apparatus.

desired higher values and greater spread between different greases.

To illustrate further the spread of bleeding rates and the accuracy of the method, the results obtained from eight typical greases are shown in Table III. These values were obtained over a period of several months, using different pieces of apparatus for the different tests. The test conditions used to get these results were ambient room temperature and air pressure regulated at 0.35 psi for a 24-hr period. The bleeding percentages shown in Tables II and III indicate that the air-pressure-type apparatus gives a much higher value and greater spread in a shorter time than the test-tube type and is fully as accurate and repeatable. The tables show only a random few of the more than 200 tests made with the apparatus.

TABLE IV.—OBSERVATIONS IN LABORATORY AND FIELD OF BLEEDING IN ORIGINAL CONTAINERS.

Grease	Extent of Oil Separation	Pressure Test Results, per cent
No. 1	Slight	6.82
No. 3	Slight to moderate	6.65
No. 4	Slight	5.47
No. 6	Slight	5.93
No. 7	Slight to moderate	8.19
No. 8	Slight to moderate	7.48
No. 11	Slight to moderate	12.55
No. 12	None to slight	5.09
No. 13	Excessive	17.28
No. 14	Slight	5.84
No. 15	Excessive	19.08
No. 16	Moderate	10.92
No. 17	Moderate	10.12
No. 18	Slight	5.82

In Table IV are shown the general observations made in the laboratory, or reported by field personnel, concerning the bleeding tendencies of some of the greases used. They were usually made upon opening a container of grease which had been in static storage for an indeterminate time. As no attempt was made to determine the amount of oil which had collected in cavities or on the surface of the grease, these observations are purely qualitative. Comparison with the quantitative results listed, and also included in Tables I, II, and III, shows the high degree of correlation claimed for the two methods.

The fairly large quantity of grease used for the test has a definite advantage. It need be weighed only to the nearest 0.5 g since, for the amount used, this variation in weight would mean a difference in the bleeding percentage of only 0.05 percentage points for all but the exceptionally high bleeding greases. Likewise weighing the oil to the nearest 0.01 g will give similar accuracy. This makes it possible for the test to be run by relatively unskilled technicians, an advantage in many laboratories. The test has been used for examining a large number of greases, and the results have been found to correlate very well with observations of bleeding in containers during static storage in the field and in the Rock Island Arsenal Laboratory.

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Evaluation of the Boor-Quartermaster Snag Tester for Coated Fabrics and Plastic Films

By Frank W. Reinhart, Catherine Brown, Ladislav Boor, and John J. Lamb

Snag resistance is determined by three observations—angle of elevation of the needle for tear, energy to tear, and type of tear. The method is recommended for testing coated fabrics and plastic films, but not uncoated fabrics.

THERE has been a need for a laboratory device to determine the snag resistance of plastic- and rubber-coated fabrics and more recently of plastic films. During the last war there was a tremendous increase in the use of these materials by the military agencies in fabrication of many important items of equipment. Such items as raincoats, ponchos, ground cloths, gun covers, and utility bags and covers are subject to snagging in service thus indicating the need for a laboratory snag testing device. Recognizing this problem, the Office of the Quartermaster General studied the nature of snag resistance and as a result designed an instrument which offered promise of determining this property satisfactorily. The Office of the Quartermaster General had the instrument built by the O. S. Peters Co. and requested the National Bureau of Standards to make an independent evaluation of the instrument and to develop a method of test based on this device. The results of the investigation are summarized in this paper.

Description of the Snag Tester

The snag tester was designed to determine the angle of elevation at which a needle on a pendulum will snag a specimen held in a plane near the horizontal, and also to determine the energy to tear.

The main features of the snag tester are a frame, a pendulum with a needle point at the center of impact, a ratchet-type catch to hold the pendulum at the end of a swing, a dial to measure the energy used by the pendulum, a specimen table that can be set at any angle from 0 to 15 deg to the horizontal plane, and a set of weights to provide tension in the specimen during the test. These features are shown schematically in Fig. 1 and photographically in Figs. 2 and 3. The mechanics of the snag tester are similar to those of an Izod or Charpy impact machine (ASTM Method D 256;[1] or Method 1071, Federal Specification L-P-406).

The specimen table is $3\frac{1}{2}$ in. wide by approximately 14 in. long. The specimen, 3 in. wide by 18 in. long, is held by the vise at one end and a set of clamps and weights at the other end. The specimen rides over a roller near the weighted end to hold it flat against the table (Figs. 1 and 2). The top surface of the roller is about $\frac{1}{4}$ in. below the plane of the specimen table. The specimen-table assembly includes a pair of parallel bars in the center which can be spaced either $\frac{1}{8}$ or $\frac{1}{4}$ in. apart. The path of the needle lies in a vertical plane through the center line of the space between the bars. During the test the specimen can deflect into the space between these bars.

The angle of elevation at which the test is made is set by rotating the specimen table about an axis parallel to the axis of rotation of the pendulum. The axis of rotation of the specimen table is immediately under the axis of rotation of the pendulum and is in the plane of the top surface of the specimen table. The angle of elevation is set by raising the end of the specimen table with an adjustment screw (Figs. 1 and 2). The screw has 24 threads per in. and is 5.5 in. from the axis of rotation of the specimen table. The head of the screw is marked

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JOHN J. LAMB, Standards Engineer, Radio Corporation of America, Camden, N. J. was from 1943 to 1951 a physicist, NBS Plastics Section. He is now working with electrical and mechanical properties of plastics and adhesives.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] Tentative Methods of Test for Impact Resistance of Plastics and Electrical Insulating Materials (D-256) 1955 Book of ASTM Standards, Part 6.

attack in this case is 30 deg; as the

TABLE I.—DESCRIPTION OF COATED FABRICS.

at 60-deg intervals and an index finger is attached beside the screw (not shown in Figs. 1 and 2). Each 60-deg interval is equal to a change in elevation of the specimen table of 0.08 deg.

The first needle used on the snag tester (Figs. 1 and 3) was a sharply tapered steel phonograph needle *A*. After the program was nearly completed it became impossible to obtain this this needle by the usual channels because their manufacture had been discontinued. Although enough of the A needles were available to do most of the testing discussed in this report, it became necessary to use a similar needle *B*. The characteristics of these steel phonograph needles are given below:

A phonograph needle was chosen for this purpose because it is an inexpensive, easily purchased item and it has the requisite strength to test coated fabrics and plastic films without breaking. Considerable breakage was encountered when attempts were made to use various types of standard penetrometer needles.

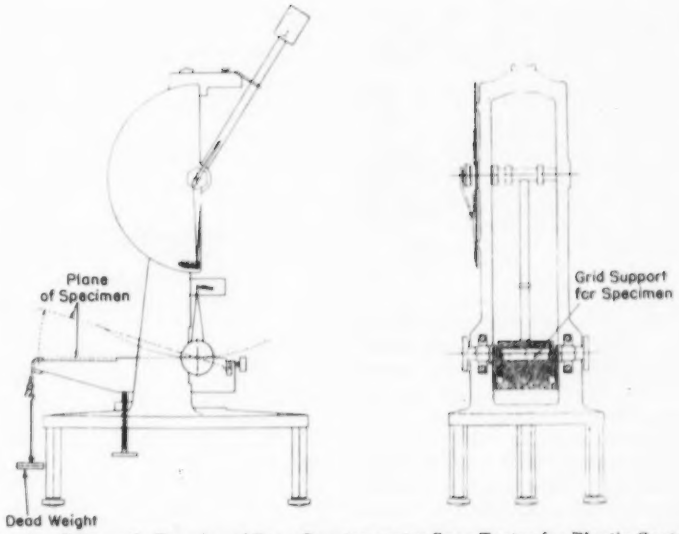

Fig. 1.—Schematic Drawing of Boor-Quartermaster Snag Tester for Plastic Coated Fabrics and Films.

Needle	Maximum Diameter, in.	Included Angle of Point, deg	Radius of Point, in.	Length, in.
A	0.069	18	0.0030	0.625
B[a]	0.058	25	0.0030	0.625

[a] See Fig. 11

The needle is held in the pendulum by a set screw and is parallel to the long dimension and on the center line of the pendulum. When the angle of elevation of the specimen table is zero, the path of the point of the needle is tangent to the specimen. The angle of

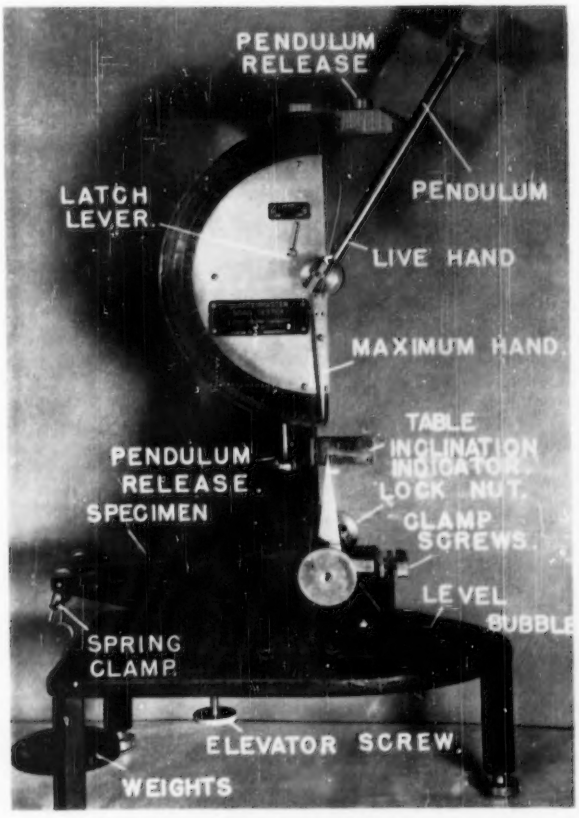

Fig. 2.—Snag Tester—Side View.

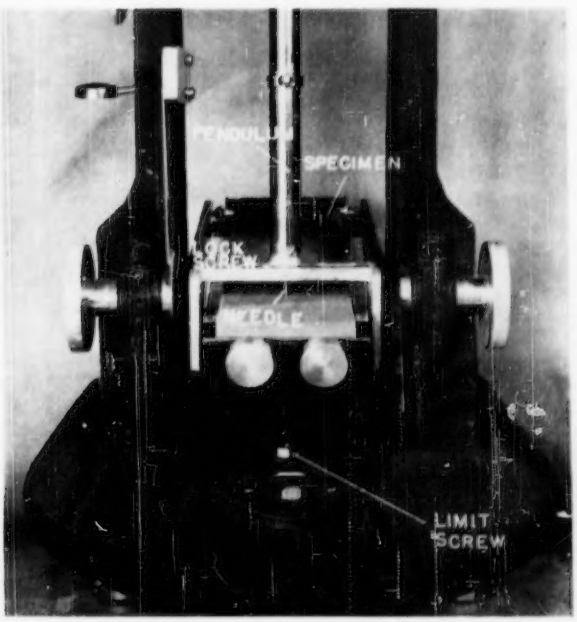

Fig. 3.—Enlarged View of Pendulum and Specimen.

The photographs in Figs. 2 and 3 were supplied through the courtesy of L. K. Hyde, O. S. Peters Co., Washington, D. C.

attack in this case is 30 deg; as the angle of elevation of the table is increased the angle of attack becomes correspondingly less.

A set of weights is provided to hold the specimen taut during the test. These range from $1\frac{1}{2}$ to 6 lb—equivalent to 0.5 lb to 2 lb per in. of specimen width for 3 in. wide specimens. These weights are clamped on the specimen as shown in Figs. 1 and 2.

Materials

The materials used were plastic- and rubber-coated fabrics and plastic films. The properties reported were determined at 23 C and 50 per cent relative humidity after storing at these conditions for at least 48 hr.

The 11 coated fabric samples are described in Table I. The tensile breaking strengths, elongations at break, and the elongations at loads of 0.5 lb per in. and 2 lb per in. of width, respectively, are reported in Table II.

The 12 plastic film samples are described in Table III. The tensile breaking factors, elongations at break, and the elongations at loads of 0.5 lb per in. and 2 lb per in., respectively, are reported in Table IV.

The tensile breaking factor and elongation at break were determined in accordance with ASTM Methods of Test D 882-49 T, Procedure B.[2] The values reported are the averages obtained with 5 lengthwise specimens of each sample.

The elongations under load were determined with strips, 18 in. long by 3 in. wide. Loads of 1.5 lb and 6 lb, respectively, were applied to the 3 in. width. The gage length was 12 in. The values reported are in inches per 12-in. gage length.

Method of Test

The testing machine is mounted on a flat surface and the adjustable feet are positioned to level the machine in accordance with the readings of the two bubble levels. The specimen table is brought to its horizontal position as indicated by the pointer attached to the axis of rotation of the table. The spacing of the two center parallel bars in the specimen table are set to form a $\frac{1}{8}$ in. wide space. With the pendulum hanging vertical, the position of the needle is adjusted to bring the point of the needle a distance above the plane of the top of the specimen table equal to the thickness of the sample to be tested.

The pendulum is raised to its starting position (Figs. 1 and 2). The dial

[2] The latest revision may be found in the 1955 Book of ASTM Standards, Part 6.

TABLE I.—DESCRIPTION OF COATED FABRICS.

Sample	Cloth	Coating Material[a]	Nominal Thickness, in.	Description
No. 1	Cotton	GR-S rubber	0.016	The inside of the roll was the coated side. The outside was uncoated cotton cloth.
No. 2	Nylon twill	Polyvinyl chloride	0.006	The two sides could not be distinguished from one another.
No. 3	Cotton percale	Polyvinyl chloride	0.010	The inside was coated with vinyl plastic. The outside was uncoated.
No. 4	Rip-stop nylon laminate	Synthetic rubber	0.007	The synthetic rubber was sandwiched between two nylon fabrics. The outside had a grid of white lines on a yellow background.
No. 5	Nylon	Polyvinyl butyral	0.007	The two sides of the material could not be distinguished from one another.
No. 6	Nylon	Polyvinyl butyral	0.007	The two sides of the material could not be distinguished from one another.
No. 7	Nylon	Polyvinyl butyral	0.007	The coated side was the inside. The outside was uncoated nylon cloth.
No. 8	Cotton	GR-S rubber	0.018	The inside was the coated side. The outside was uncoated.
No. 9	Nylon	Polyvinyl chloride	0.009	Both sides were coated but were different in color.
No. 10	Nylon	Polyvinyl butyral	0.007	The inside was the coated side. The outside was uncoated.
No. 11	Cotton	Dryfast GR-S rubber	0.010	The inside was the coated side. The outside was uncoated.

[a] Only sample 9 was coated on both sides.

TABLE II.—TENSILE PROPERTIES OF COATED FABRICS.

Sample	Orientation of Specimens	Tensile Breaking Factor, lb per in. width	Tensile Elongation at Break, per cent	Elongation Under Load, in. per 12 in. gage length	
				0.5 lb per in. width	2.0 lb per in. width
No. 1	Lengthwise	58	20	0.02	0.06
	Diagonal	...	...	0.10	0.35
No. 2	Lengthwise	50	33	0.06	0.12
	Diagonal	...	...	0.38	1.06
No. 3	Lengthwise	49	20	0.06	0.12
	Diagonal	...	...	0.35	1.14
No. 4	Lengthwise	73	31	0.05	0.10
	Diagonal	...	...	0.12	1.04
No. 5	Lengthwise	71	42	0.06	0.12
	Diagonal	...	...	0.22	0.92
No. 6	Lengthwise	70	62	0.09	0.15
	Diagonal	...	...	0.62	1.46
No. 7	Lengthwise	60	24	0.12	0.17
	Diagonal	...	...	1.58	3.42
No. 8	Lengthwise	42	21	...	...
	Diagonal	...	...	0.12	0.62
No. 9	Lengthwise	72	32	...	...
	Diagonal	...	...	0.33	1.06
No. 10	Lengthwise	66	70	...	...
	Diagonal	...	...	0.94	2.38
No. 11	Lengthwise	43	16	...	...
	Diagonal	...	...	0.12	0.60

TABLE III.—DESCRIPTION OF UNSUPPORTED PLASTIC FILMS.

Sample	Nominal Thickness, in.	Description
Vinyl Chloride:		
A	0.012	Olive green; one side has a glossy finish, the opposite side is dull.
B	0.012	Transparent, grayish color; both sides are smooth.
C	0.012	Gray with mottled effect on one side and solid gray on the reverse side.
D	0.008	Transparent, bluish color; both sides are smooth.
E	0.008	Transparent, whitish color; one side is smooth, the opposite side is semi-mat.
F	0.004	Transparent, whitish color; both sides are smooth.
G	0.004	Transparent; one side is smooth, the opposite side semi-mat.
H	0.004	Transparent, whitish color; both sides are smooth.
I	0.004	Transparent; both sides are smooth.
J	0.004	Transparent; one side is smooth, the opposite side is semi-mat.
Polyethylene:		
K	0.004	Transparent; smooth finish on both sides.
L	0.002	Transparent; smooth finish on both sides.

The second test is then made at an angle of elevation 0.08 deg greater than

were tested under loads of 6 lb unless otherwise stated.

mens of each of samples Nos. 8, 9, 10, and 11 were tested in the order in which

TABLE IV.—TENSILE PROPERTIES OF PLASTIC FILMS.

Sample	Orientation of Specimens	Tensile Breaking Factor, lb per in. width	Tensile Elongation at Break, per cent	Elongation under Load, in. per 12 in. gage length	
				0.5 lb per in. width	2.0 lb per in. width
A	Lengthwise	25	575	0.81	3.02
	Diagonal			0.81	2.90
B	Lengthwise	39	420	0.12	0.50
	Diagonal			0.10	0.44
C	Lengthwise	42	460	0.10	0.42
	Diagonal			0.08	0.40
D	Lengthwise	30	410	0.12	0.71
	Diagonal			0.17	0.81
E	Lengthwise	22	330	0.40	1.40
	Diagonal			0.33	1.44
F	Lengthwise	12	240	0.44	1.88
	Diagonal			0.56	2.25
G	Lengthwise	12	285	0.46	2.25
	Diagonal			0.46	2.32
H	Lengthwise	17	220	0.47	2.25
	Diagonal			0.53	2.50
I	Lengthwise	13	250	0.41	1.94
	Diagonal			0.50	Broke
J	Lengthwise	13	335	0.19	1.38
	Diagonal			0.28	1.62
K	Lengthwise	7	705	0.12	0.34
	Diagonal			0.06	0.31
L	Lengthwise	4	345	0.25	Broke
	Diagonal			0.34	Broke

pointer is placed against the stop at the bottom of the dial, the latch lever on the dial is moved to the "On" position, and the pendulum released. A reading of the resultant position of the pointer is taken and is called "friction with pointer." Then two swings of the pendulum are made to determine the friction and windage. These are determined before testing each sample to make certain the pendulum is operating correctly. With this particular machine, the friction and windage were always less than 0.040 ft-lb; the values were reproducible in a consecutive series of tests to within a range of 0.003 ft-lb. At the end of the swing the pendulum is caught by the ratchet-type latch; this latch must be turned to the "Off" position each time before the pendulum is returned to its initial position. This latch is necessary to prevent the pendulum from making a rebound and damaging the specimen.

The "Up and Down" (hereafter called UD) system[3] is used to test the specimens to determine angle for tear. This system was developed for testing an object that could be subjected to only one valid test, such as a drop from a certain height, and then would not be tested again, even though it did not break on the first impact. The average angle at which the specimen fails is bracketed by raising or lowering the test angle for each consecutive test in accordance with non-failure or failure, respectively, in the previous test. In exploratory tests, intervals of 0.5 deg angle of elevation are used; thereafter the interval is 0.08 deg angle of elevation.

For example in Fig. 5, sample no. 3 lengthwise, the first test was made at 5.46 deg. The specimen gave a tear, therefore, the second test was made at 5.38 deg one interval below the first test. There was no tear at this angle. Since, the UD system requires that after a no tear the following test shall be made at a large angle of elevation, the third test was made at 5.46 deg. A tear occurred at this angle of elevation thus the fourth test was made at 5.38 deg. This testing pattern was used for all the tests reported in this paper unless otherwise specified.

In testing a group of specimens, one of the specimens is inserted in the machine and the angle of elevation is set at one division on the screw below the maximum angle at which tear did not occur in exploratory tests. The pendulum is then released. For a second test on the same end of a specimen that did not tear in the preceding test the weight is removed, the specimen is lifted off the table, the ratchet latch lever is pushed to "Off," and the pendulum is returned to its original position. The vise is then opened and the specimen is moved laterally 0.5 in.

[3] This system of testing is named the "Up and Down" method by W. J. Dixon and A. M. Mood, "A Method for Obtaining and Analyzing Sensitivity Data," *Journal Am. Statistical Assn.*, Vol. 43, March, 1948, p. 109.

TABLE V.—EFFECT OF REPLACING NEEDLES[a] ON ANGLE FOR TEAR OF COATED FABRICS.

Sample	Orientation of Specimen	Whole Group			First Set		Second Set		Difference in Angle for Tear Between First and Second Sets, deg
		Number of Tears	Angle for Tear, deg	Standard Deviation, deg	Number of Tears	Angle for Tear, deg	Number of Tears	Angle for Tear, deg	
No. 1	Lengthwise	17	6.69	0.31	9	6.00	8	6.20	0.20
	Diagonal	16	5.93	0.12	8	5.93	8	5.94	0.01
No. 2	Lengthwise	17	4.49	0.88	11	4.21	6	4.68	0.47
	Diagonal	9	5.30	0.65	6	5.19	3	5.47	0.28
No. 3	Lengthwise	17	5.40	0.07	9	5.40	8	5.40	0.00
	Diagonal	9	5.64	0.07	5	5.64	4	5.65	0.01
No. 4	Lengthwise	17	4.56	0.13	10	4.49	7	4.66	0.17
	Diagonal	9	5.30	0.19	3	5.22	6	5.33	0.11
No. 5	Lengthwise	19	4.40	1.14	9	4.64	10	4.20	0.44
	Diagonal	16	4.84	0.47	8	4.74	8	4.93	0.19
No. 6	Lengthwise	18	5.81	0.14	10	5.75	8	5.70	0.05
	Diagonal	12	7.19	1.97	4	6.85	8	7.38	0.47
No. 7	Lengthwise	10	7.01	0.56	3	7.18	8	6.72	0.46
	Diagonal	9	8.98	1.25	4	9.04	5	9.17	0.13
No. 8	Diagonal	28	5.99	0.04					
No. 9	Inside[b] diagonal	22	5.90	0.47					
	Outside[b] diagonal	26	6.18	0.15					
No. 10	Diagonal	13	7.06	1.04					
No. 11	Diagonal	30	5.25	0.22					

[a] Each set of specimens was tested at different times with different needles of the same type. Coated side tested.
[b] Indicates inside and outside of roll of coated fabric sample No. 9 (see Table I).

Sample 1 Lengthwise

Sample 5 Lengthwise

The second test is then made at an angle of elevation 0.08 deg greater than that used in the first test. At various times during the early experiments, one to five tests were made on each end of the specimen. However, it was found that even with no tears, the results of tests made less than 0.5 in. from a previous test are affected. The needle on the pendulum first touches the specimen about 3 in. from the vise. Since the length of the line of contact between the needle and the specimen is rarely more than 2 in. long, the other end of the 18-in. long specimen is also available for test by rotating it through 180 deg. The maximum number of tests possible on one specimen is four, two on each end.

The angles for tear and standard deviations reported in the tables are calculated from the individual test results as follows:

$$\bar{x} = x_0 + \delta(A/N \pm 1/2)$$

$$s = 1.620\delta\left(\frac{NB - A^2}{N^2} + 0.029\right)$$

δ = increment of x, in the snag tests = 0.08 deg of angle of elevation;
N = lesser number, either of tears or no tears;
x_0 = lowest angle of elevation at which anyone of N occur;
A = $\Sigma i n_i$, where x_0, x_1, x_2, x_3, etc., are the angles in the range of angle where N occur, i is the subscript of x, and n_i is the number of tears or no tears, whichever is pertinent, at the level of i; and
B = $\Sigma i^2 n_i$.

The negative sign is used in the parentheses when N refers to tears, and the positive sign when N is the number of "no tears." The range of angle for tear is reported as extending from the maximum angle at which no tears occur in every test to the minimum angle at which tears occur in every test.

Test Specimens

A series of tests was made in which specimens were cut with the long dimension parallel, at 22.5 deg, at 45 deg, at 67.5 deg, and crosswise to the length of the roll, and another series in which the loads holding the specimens under tension during test were 1.5 and 6 lb, respectively. The highest values for the average angle for tear were obtained with the specimens that were cut at 45 deg and the lowest in the crosswise direction. The lengthwise, 22.5 deg and 67.5 deg orientations gave intermediate values. There was indication that the higher tension gives higher average angles for tear. Consequently, only lengthwise and diagonal specimens were tested under loads of 6 lb unless otherwise stated.

A new needle was used for each group of specimens of a sample, unless otherwise stated. The specimens cut in the two orientations are considered as two groups.

Results for Coated Fabrics

Angle for Tear

The first series of tests was made with coated fabrics, samples Nos. 1 through 11. Each group of 12 specimens of samples Nos. 1 to 7, inclusive, was divided into two sets of six each, which were tested at different times with different needles. The results of these tests are presented in Table V. The differences between the angles for tear for the two sets of specimens for each direction of each sample are attributed to changing the needles, other experimental error, testing at different times, and lack of randomness and normal fluctuations within the samples. However, the major source of the differences is attributed to changing the needles. Twenty diagonal specimens of each of samples Nos. 8, 9, 10, and 11 were tested in the order in which they were cut from their respective rolls and not in a random order within a sample. These values are also reported in Table V.

Assistance in studying the individual test results by the UD method is obtained by making a graphical plot of the results. Plots for some of the data reported in Table V are given in Figs. 4, 5, 6, and 7. Two marks in a vertical column indicate the two tests (needle passes) on that end of the specimen. When the first test on one end tore the specimen, it was not possible to make a second test on that end. There were cases where the tear was such that the other end of the specimen could not be tested.

A detailed analysis of the data in Figs. 4 to 7 was made to determine the occurrence of no tears in these tests. The results are presented in Table VI. The data for several of the samples indicate that the second test on the same end of the specimen is influenced by a physical change caused by the first test, even though the test areas were 0.5

TABLE VI.—OCCURRENCE OF NO TEARS ON ONE END OF EACH SPECIMEN REPORTED IN FIGS. 4 TO 7.

Sample	Orientation of Specimen[a]	Occurrence of No Tears on One End of Specimen in Snag Test	
		Two (No Tears)	One (Tore in Second Test)
No. 1	Lengthwise	7	6
	Diagonal	8	0
No. 2	Lengthwise	6	4
	Diagonal	4	4
No. 3	Lengthwise	5	4
	Diagonal	8	1
No. 4	Lengthwise	7	8
	Diagonal	7	4
No. 5	Lengthwise	3	2
	Diagonal	6	5
No. 6	Lengthwise	5	7
	Diagonal	11	2
No. 7	Lengthwise	3	1
	Diagonal	3	2
No. 8	Diagonal	11	6
No. 9	Diagonal	12	6
	Diagonal-X	10	11
No. 10	Diagonal	12	0
No. 11	Diagonal	10	7

[a] The inside of the specimens was tested except for the one marked X which was the outside of the roll.

TABLE VII.—ANGLE FOR TEAR OF OPPOSITE SIDES OF THREE COATED FABRICS.

Sample	Side of Fabric	Number of Tears[a]	Angle for Tear, deg		
			Average	Deviation	Range
No. 1	Inside	14	6.03	0.12	5.92 to 6.15
	Outside	12	5.31	0.06	5.31 to 5.46
No. 2	Inside	10	5.72	0.32	5.46 to 5.92
	Outside	10	5.41	0.14	5.31 to 5.61
No. 4	Inside	12	5.29	0.15	5.16 to 5.46
	Outside	10	5.41	0.14	5.31 to 5.61

[a] Fifteen diagonal specimens of each sample were tested. Only one test (needle passes) was made on each end of the specimen.

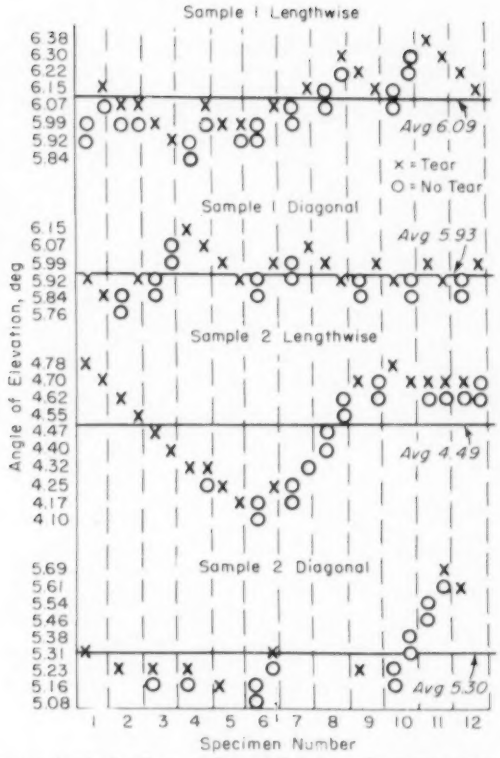

Fig. 4.—Angle for Tear of Coated Fabric as Determined by the UD Method.

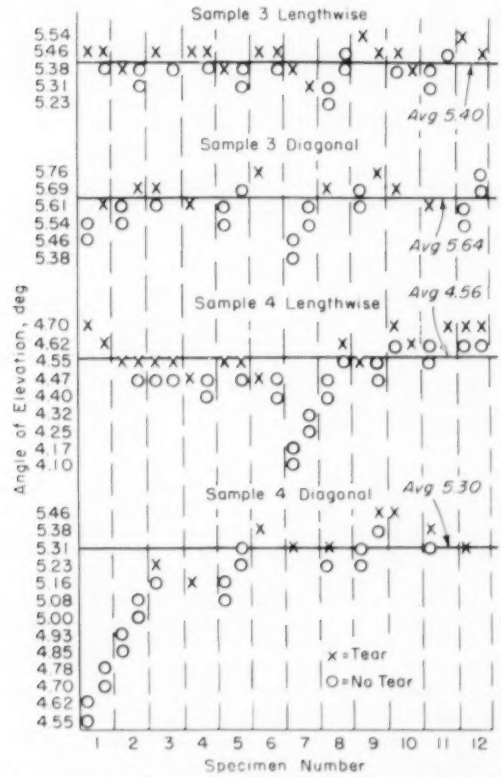

Fig. 5.—Angle for Tear of Coated Fabric as Determined by the UD Method.

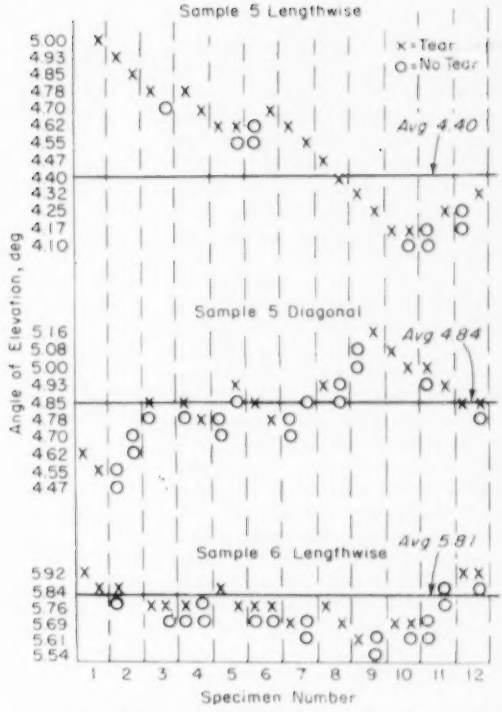

Fig. 6.—Angle for Tear of Coated Fabric as Determined by the UD Method.

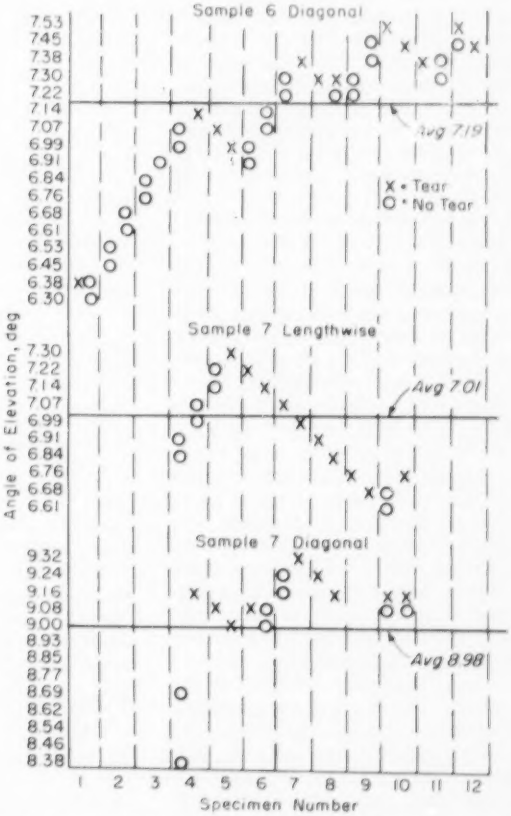

Fig. 7.—Angle for Tear of Coated Fabric as Determined by the UD Method.

in. apart on the specimen. The large number of paired "No tears" for the samples may also be caused partially by a lack of randomness resulting from making the two tests on the same end of the specimen consecutively.

The results of tests made on the opposite sides of diagonal specimens of samples Nos. 1, 2, and 4 are presented in Table VII. A random choice of specimens was made so that the two groups of specimens from the same fabric would represent the same sample. The results indicate a definite difference in snag resistance between the two sides of the fabric in sample No. 1, with the coated side having the higher angle. The range of values for the angle of elevation for tear and the consequent standard deviation are small, indicating the efficiency of the UD method. The test could have been made more random by testing the two ends of the specimens in a different order, but apparently testing them in succession has caused no bias.

Energy to Tear

Initially, it was planned to obtain data on the energy to tear in the same tests used to determine the minimum angle of elevation for tear. Many of the tears in these tests were small, ranging from $\frac{1}{8}$ to $\frac{1}{2}$ in. The machine reading, besides indicating the energy absorbed in the tear, also includes the friction and windage of the pendulum and some frictional energy loss due to the needle scraping the fabric before the tear starts. For these small tears, the total correction factor was approximately 70 per cent of the machine reading for energy to tear. The machine readings were quite variable and the length of tear also variable with no correlation between the energy absorption readings and the lengths of tear. Consequently, it was decided to measure the energy to tear at angles of elevation sufficient to create long tears.

The values of energy to tear per inch of tear given in Table VIII were obtained in tests made at an angle of elevation high enough to obtain long tears in which the readings were 1 ft-lb or more. In these tests, the effects of friction were negligible, since at the higher angle of elevation the needle usually starts a tear as soon as it touches the fabric, and, second, the correction for the friction and windage of the pendulum is inversely proportional to the energy used in the tear. The calculated energy per inch of tear values in Table VIII are at most 3 per cent high, since no corrections were made.

A comparative coefficient of friction for the rubbing of a needle against the specimen could be calculated by subtracting the appropriate corrections for friction and windage from the total frictional energy. In this way the surface characteristics of the samples, an important variable in snagging in service, could be compared.

TABLE VIII.—ENERGY TO TEAR COATED FABRICS.

Sample	Orientation of Specimen	Number of Specimens	Angle of Elevation, deg	Average Length of Tear in $\frac{1}{8}$-in. Units	Energy to Tear, ft-lb per in. of tear	
					Average	Range
No. 1	Lengthwise	20	6.5	30	0.47	0.39 to 0.57
	Diagonal	10	6.5	67	0.44	0.41 to 0.47
No. 2	Lengthwise	20	6.0	35	0.19	0.17 to 0.21
	Diagonal	10	6.5	72	0.26	0.25 to 0.30
No. 3	Lengthwise	20	6.5	32	0.29	0.26 to 0.32
	Diagonal	10	6.5	69	0.35	0.32 to 0.44
No. 4	Lengthwise	20	6.0	29	0.17	0.15 to 0.20
	Diagonal	10	6.5	66	0.37	0.30 to 0.49
No. 5	Lengthwise	20	5.5	26	0.21	0.17 to 0.30
	Diagonal	10	5.5	76	0.33	0.31 to 0.36
No. 6	Lengthwise	20	7.0	59	0.36	0.28 to 0.39
	Diagonal	10	8.5	69	0.43	0.38 to 0.58
No. 8	Diagonal	10	7.53	58	0.53	0.42 to 1.10
No. 9	Diagonal	10	6.84	45	0.28	0.22 to 0.43
No. 10	Diagonal	10	7.76	40	0.63	0.40 to 0.78
No. 11	Diagonal	10	6.15	40	0.32	0.26 to 0.42

TABLE IX.—EFFECT OF WEAR OF NEEDLE ON ANGLE FOR TEAR OF COATED FABRICS.

Sample	Orientation of Specimens	Test Group[a]	Number of Tears	Angle for Tear, deg		
				Average	Standard Deviation	Standard Error
No. 2	Lengthwise	1	15	5.08	0.07	0.017
		2	15	4.94	0.27	0.071
		3	16	5.00	0.03	0.009
		All specimens	46	5.01	0.19	0.028
No. 2	Diagonal	1	9	5.36	0.16	0.053
		2	10	5.68	0.10	0.033
		3	13	5.02	0.03	0.013
		All specimens	32	5.40	1.36	0.257
No. 4	Lengthwise	1	17	4.73	0.05	0.012
		2	14	4.75	0.04	0.011
		3	15	4.71	0.05	0.013
		All specimens	46	4.73	0.05	0.008
No. 4	Diagonal	1	11	4.93	0.03	0.010
		2	12	4.88	0.03	0.010
		3	14	4.88	0.04	0.010
		All specimens	37	4.89	0.04	0.007

[a] Each test group is composed of ten specimens. All tests were made with one needle.

TABLE X.—COMPARISON OF ANGLES FOR TEAR WITH A AND B NEEDLES.[a]

Sample	Orientation of Specimen	Needle *A* Angle for Tear,[b] deg	Needle *B* Angle for Tear, deg
No. 2	Lengthwise	4.49;	5.37
No. 2	Diagonal	5.30; 5.72	6.42
No. 4	Lengthwise	4.56;	4.98
No. 4	Diagonal	5.30; 5.29	5.86

[a] Each value reported is the average obtained with ten specimens.
[b] Two sets of specimens were tested in the diagonal direction of samples Nos. 2 and 4.

Needle Variations

Tests were made to determine whether the needle was a significant variable in the test method. The ability of the operator to repeat settings of the needle and the uniformity of the needles are shown in the data in Table V.

The data in Table IX represent tests made with only one needle on three groups of ten specimens each of samples Nos. 2 and 4. The tension was 1.5 lb. After the first 40 specimens were tested, 10 of each sample and orientation, the needle was used in 100 simulated tests (needle passes) on other specimens at angles of elevation such that the needle would rub over as much as possible of the specimen without tearing it. Another group of 100 simulated tests was also inserted between the second and third groups of 40 specimens.

Since four passes of the needle was

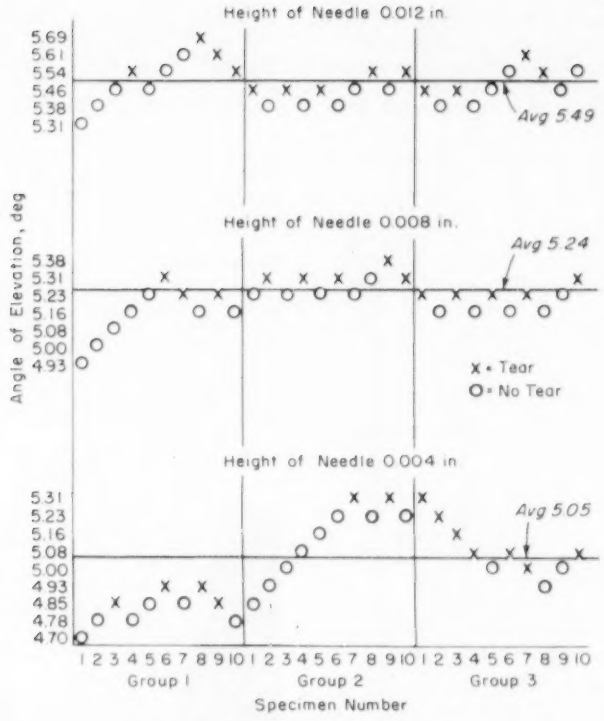

Fig. 8.—Tests of Coated Fabric Sample 2.

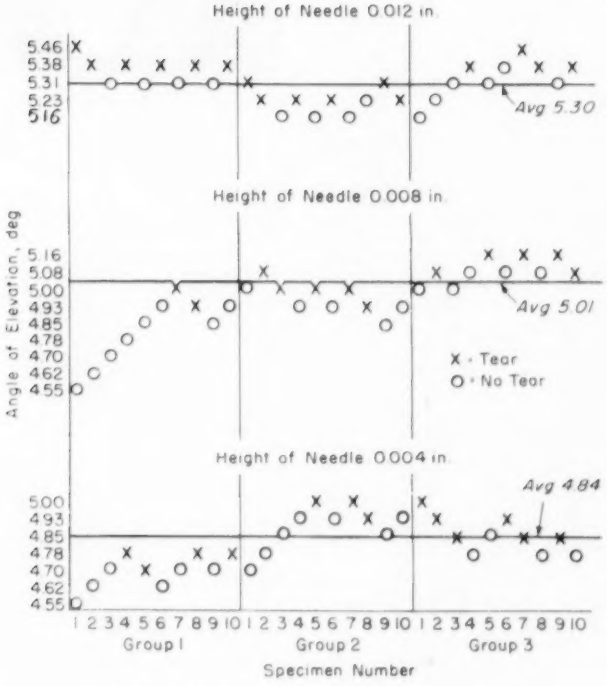

Fig. 9.—Tests of Coated Fabric Sample 4.

the maximum required for one specimen, the combination of the simulated tests and the tests of the second group was equivalent to testing approximately 120 specimens between the first and third groups of 10 specimens from one direction of a sample. If the needle had become dull or shorter during these tests, the third group shown in Table IX would have the highest average angles of elevation for tear. This did not occur for any of the four combinations of sample and orientation of specimen tested.

When it became evident that the *A* needles could no longer be obtained, comparison tests were made with *B* needles, using specimens of samples Nos. 2 and 4. The results are presented in Table X. These results show that the one type of needle cannot be substituted for the other. Cursory tests made with other needles confirm this observation. Except for the data in Table X, all the results on the coated fabrics reported were obtained with the *A* needle.

Tests were made with the *B* needle and lengthwise specimens of coated fabric samples Nos. 2 and 4 with the needle set at three different heights of the point of the needle above the specimen table. The thicknesses of these two samples are 0.006 and 0.007 in. respectively. The heights of the needle setting used were 0.004, 0.008 and 0.012 in. The results of these tests are shown graphically in Figs. 8 and 9 and are summarized in Table XI. The results show a definite trend to higher angles for tear with greater needle height. The rate of change for these two samples is about 0.18 deg for the change from 0.004 to 0.008 in. and about 0.27 deg for the change from 0.008 to 0.012 in. in setting of the height of the needle. This effect is expected from the geometry of the machine. The results obtained for samples Nos. 2 and 4 at the settings of 0.004 and 0.008 in. are considerably higher than those obtained previously at settings of 0.006 and 0.007 in., respectively, with these materials. This is attributed to the fact that *B* and *A* needles, respectively, were used in the two series of tests and that the tests at the needle setting of 0.004 and 0.008 in. were made after the materials had aged 15 months.

Tension Variation

During the snag test, the specimen can deflect into the groove of the specimen table and allow the needle to pass over the specimen without tearing. It could be assumed that increased tension on the specimen, that is, using 6.0- rather than 1.5-lb tension during the test, would lessen the ability of the specimen to deflect into the groove.

Thus, the angle for tear would be less at the greater tension. The preliminary test results did not support these assumptions; rather, a reverse tendency was noted.

Stiffness of Sample

The value of angle for tear is dependent upon a combination of surface finish or friction, the inherent snag resistance of the material, and the stiffness of the specimen. The stiffness of the samples is related to their elongation. Their elongations under the 1.5- and 6.0-lb loads used to hold the specimens taut during the snag test are reported in Table II.

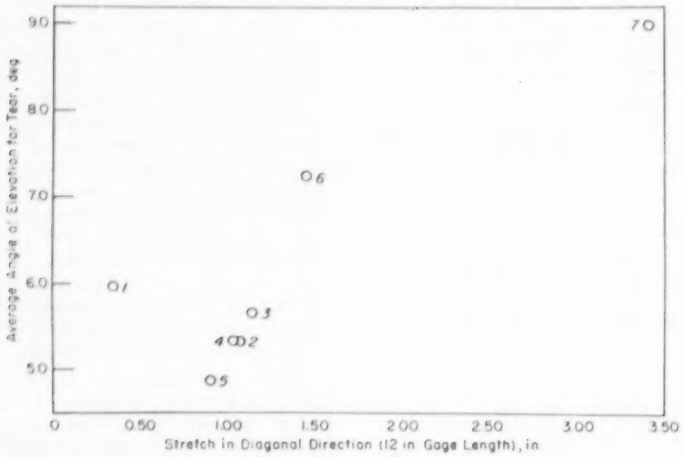

Fig. 10.—Relationship Between the Elongation of the Coated Fabrics and the Angle for Tear.

TABLE XI.—EFFECT OF NEEDLE SETTING ON ANGLE FOR TEAR.

Height of Needle, in.	Angle for Tear, deg			
	Sample No. 2		Sample No. 4	
	Average	Standard Deviation	Average	Standard Deviation
0.004	5.05	0.55	4.84	0.20
0.008	5.24	0.07	5.01	0.13
0.012	5.49	0.10	5.30	0.12

The general effect of stiffness in the test specimen is to lower the angle for tear, regardless of the effect of tension in the specimen which was just discussed. The largest angles for tear occur in those samples showing the greatest elongation. The values of elongation for 6.0-lb load from Table II are plotted against values of angles for tear from Table V in Fig. 10.

Types of Tear

Two types of tears were commonly observed in the tests. The first, more important in the present tests because it is typical of the tears of coated fabrics in actual use, is a right angle tear in which the needle strikes the fabric in the

Fig. 11.—Needle *B* Shadowgraph.

TABLE XII.—ANGLES FOR TEAR AND LENGTHS OF TEAR OF PLASTIC FILMS.

Sample	Orientation of Specimen	Angle for Tear, deg		Angle of Greatest Number of Tears, deg	Average Length of Tear,[a] in.	Type of Tear
		Average	Standard Deviation			
A	Lengthwise	5.37	0.03	5.38	1.24	Y-shaped
	Diagonal	5.50	0.03	5.54	1.24	Y-shaped
B	Lengthwise	6.08	0.38	6.07 to 6.30	0.89	Straight line
	Diagonal	6.42	0.03	6.45	0.85	Straight line
C	Lengthwise	5.43	0.29	5.46	0.38	Straight line
	Diagonal	5.48	0.02	5.46	0.31	Straight line
D	Lengthwise	5.15	0.30	5.08 to 5.16	0.39	Straight line
	Diagonal	5.53	0.06	5.61	0.02	Straight line
E	Lengthwise	5.28	0.04	5.31	0.04	Straight line
	Diagonal	5.33	0.10	5.31	0.04	Straight line
F	Lengthwise	4.81	0.11	4.85	1.18	Y-shaped
	Diagonal	4.92	0.14	4.93	1.87	Y-shaped
G	Lengthwise	4.98	0.10	5.00	0.67	Y-shaped
	Diagonal	4.97	0.07	5.00	1.56	Y-shaped
H	Lengthwise	4.89	0.00	4.93	0.07	Straight line
	Diagonal	4.83	0.02	4.85	0.26	Straight line
I	Lengthwise	4.88	0.02	4.93	2.89	Y-shaped
	Diagonal	4.92	0.06	5.00	3.96	Y-shaped
J	Lengthwise	5.07	0.03	5.08	1.00	Y-shaped
	Diagonal	5.11	0.02	5.16	1.95	Y-shaped
K	Lengthwise	5.01	0.03	5.00 to 5.08	2.80	Y-shaped, ruffled edges
	Diagonal	4.98	0.07	5.00 to 5.08	2.50	Y-shaped, ruffled edges
L	Lengthwise	4.20	0.05	4.25	1.94	Y-shaped, ruffled and torn edges
	Diagonal	4.40	0.07	4.40	0.14	Y-shaped, ruffled and torn edges

[a] On Y-shaped tears the length of tear is the length in inches of legs of Y plus stem of Y.

diagonal direction, snags the fabric at the apex of the right angle, and lifts a flap. The tear occurs at a 45-deg angle to the path of the needle, that is, in the lengthwise and crosswise directions of the fabric.

The second type of tear, which was common when the needle path was parallel to the lengthwise or crosswise directions, is a slit. This slit-type tear also occurred in tears of material more isotropic than the coated fabrics, in particular plastic films.

The right angle type of tear was to be evaluated in these tests and for that reason most of the tests were made in the diagonal directions. In some experiments, tests were made at 22.5 deg to the lengthwise and crosswise directions. In these tests the tears were also parallel to the warp and filling threads.

Tests on Uncoated Fabrics

Attempts made to determine the snag resistance of several uncoated fabrics were unsuccessful. The fabrics, because of their low stiffness, deflected into the $\frac{1}{8}$-in. groove under the needle in some cases so that no tears were obtained. When tears were obtained, the results were erratic or the needle stuck in the fabric and did not swing free. It may be necessary to apply tension both lengthwise and crosswise to test uncoated fabric specimens.

Results for Plastic Films

The angle for tear under a load of 1.5 lb was measured in the lengthwise and and diagonal directions of the twelve unsupported plastic films. Ten lengthwise and ten diagonal specimens were cut from each plastic film, except that for samples E, K, and L there was not sufficient material for ten diagonal specimens. One test was made on each end of a specimen. The *B* steel phonograph needle was used in making all the tests. A new needle was used for the testing of each sample.

The results reported in Table XII show the thicker the film the greater the angle of elevation for tear based on the average of the two directions. The agreement between the angle for tear and the pattern of tear for the lengthwise and diagonal directions of the twelve samples tested indicates that there is no significant difference between the lengthwise and diagonal directions of these films. Eight of the twelve films tested gave a lower standard deviation for the diagonal direction than for the lengthwise direction. This is attributed to the fact that results of the tests in the lengthwise direction were used to select the angle for starting the tests in the diagonal direction.

The energy to tear was measured on nine of the unsupported plastic films. To produce a tear on each release of the pendulum, the angle of elevation was set above the observed angle for tear. The energy to tear was calculated by dividing the ft-lb load required to produce a tear by the length of tear in inches. The results are presented in Table XIII. In general, there is no definite relation between the stiffness of the films as expressed by the elongation under load and the values for energy to tear and angle for tear. The most flexible material, *A*, had the highest energy to tear.

Figure 12 shows twenty-four tests with fifteen specimens. Results from the first three specimens show preliminary bracketing. Tests of diagonal specimens often cause such a long tear across the specimen that the other end of the specimen could not be held at uniform tension while the second test was made. The results of the tests in Fig. 12 give an angle for tear of 6.3 deg.

TABLE XIII.—ENERGY TO TEAR FOR PLASTIC FILMS.

Sample	Number of Specimens	Length of Tear		Energy to Tear	
		Average, in.	Range, in.	Average, ft lb per in.	Range of Tear, ft lb per in.
A	7	1.20	1.13 to 1.25	1.64	1.55 to 1.78
B	3	1.29	1.06 to 1.44	0.74	0.68 to 0.80
C	9	1.19	0.88 to 1.50	0.68	0.52 to 1.05
D	5	0.64	0.31 to 0.75	0.60	0.55 to 1.12
F	6	1.26	0.31 to 2.25	0.66	0.22 to 0.96
G	6	0.62	0.12 to 2.25	0.89	0.80 to 1.01
H	6	0.40	0.19 to 0.44	0.51	0.34 to 0.85
I	6	2.64	0.19 to 3.19	0.70	0.60 to 0.78
J	6	0.68	0.12 to 2.75	0.92	0.71 to 1.20

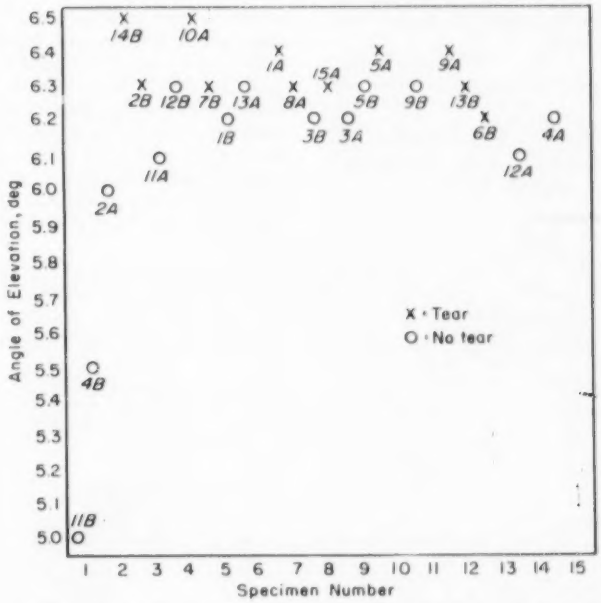

Fig. 12.—Results of a Typical Snag Test of a Coated Fabric by the UD Method.

Some Volume Changes in Mortars and Concrete*

By F. O. Anderegg and J. A. Anderegg

Observations on autoclave expansion of neat cement and masonry movements, sand grading and shrinkage in mortar and concrete, and moisture movement in concrete made from cement blends.

I AUTOCLAVE EXPANSION OF NEAT CEMENTS AND MASONRY MOVEMENTS

McBURNEY's proposal as set forth in his paper presented before the Society in 1952 (1)[1] of a 1 per cent maximum autoclave expansion for masonry cements was based on extrapolation of results obtained with cementitious materials containing dolomitic limes and having autoclave expansions ranging from 12.9 to 17.7 per cent. A high-calcium lime in a similar mixture caused an expansion of only 0.08 per cent. The interval between these extremes was not explored.

To shed light on this intermediate region, a series of masonry cements was collected, with autoclave expansions ranging from 0.4 to 10 per cent. With 1:3 (by volume) mortars prepared therefrom, three series of piers were erected. The bricks employed in the piers had an absorption range of 15 to 25 g for 60 sec. One set of 8-ft piers was built outdoors adjacent to a Waylite block wall 5 yr old (Fig. 1) and a second set was built indoors with lever arms to increase the sensitivity of measurement. The third set of 36-in. piers was built indoors at constant temperature of 70 ± 2 F, a dial, reading to 0.0001 in., being placed in contact with each pier as soon as the pier was finished.

The 8-ft piers, made of cementitious materials having autoclave expansions up to 10 per cent, showed no evidence of expansion as great as 0.01 per cent in 2 yr. One pier, built with a 1:2:9 mortar containing a normally hydrated dolomitic lime, apparently expanded 0.14 per cent in 2 yr, but no evidence of unsoundness could be observed. This mortar in a 36-in. pier at constant temperature expanded 0.03 per cent or 0.36 in. per 100 ft during the first seven days. Thereafter it shrank, reaching a residual net expansion of 0.24 in. per 100 ft in six months.

T. L. Webb (2) who has made a study of dolomitic limes states, "many local limes which prove satisfactory in use, when tested by the autoclave method, have expansion above 7 per cent, more than seven times as high as the 1 per cent limit proposed by McBurney."

It is well known that the rigidity of a specimen has considerable effect on the expansion in the autoclave. Neat cements are generally more rigid than mortars. It is *mortars* with which masonry is built and not neat cements. Mortars, rather than neat cements, should be used accordingly in soundness tests. When, for instance, neat air-entraining portland cements are frozen, they fail miserably, whereas their contribution to the resistance of concrete to freezing and thawing is outstandingly good.

The series of masonry cements used in the piers was fabricated into neat and mortar specimens for autoclaving. The mortar was molded between bricks having 60-sec absorptions ranging from 15 to 25 g with inserts placed in the soft mortar. The bricks had been given a coating of lime on one side, permitting removal of the whole mortar slab.

The results on autoclave testing at various ages are given in Table I.

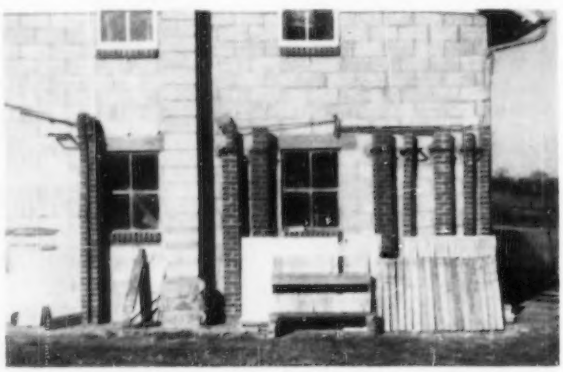

Fig. 1.—Brick Piers Built in 1952 with a Series of Masonry Cements.

In 18 months the maximum growth as compared with the Waylite block wall in the background has been but one part in 100,000. The cements showed up to 10 per cent autoclaved expansion heat.

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J. A. ANDEREGG took his Master's degree at Iowa State College in 1951 and has since done graduate work at Rutgers University and assisted in the Anderegg laboratory.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to ASTM Headquarters, 1916 Race St., Philadelphia 3, Pa.

* Presented at the Fifty-Seventh Annual Meeting of the Society, June 13–18, 1954.

[1] The boldface numbers in parentheses refer to the list of references appended to this paper.

TABLE I.—AUTOCLAVE EXPANSION OF NEAT AND MORTAR SPECIMENS, PER CENT

Age	2 days	7 days	28 days	90 days	1 yr
Neat Specimens					
N 1[a]		10.0[g]	10.0[g]	1.4	...
N 2[a]	0.38	0.28	0.19	0.32	...
N 3[a]	[g]	[g]	[g]	4.3[g]	...
Q[a]	0.07	0.25	0.09	0.08	...
P[b]	0.14	0.12	0.16	0.14	...
M 1[c]	0.47	0.29	0.21	0.21	...
M 2[d]	0.68	0.38	0.33	0.25	0.35
H 1[e]	2.40	1.14	0.47	0.36	...
H 2[e]	0.34	0.63	0.28	0.42	...
H 3[e]	1.74[h]	0.36	0.22	0.27	0.33
P:LI[f] (1:1)	10.6	19.6	23.2	...	16.0
B 1 (N 1:P = 1:1 blends, no sand)	...	0.09	0.12	0.25	...
B 2 (N 2:P = 1:1 blends, no sand)	...	0.13	0.23	0.14	...
B 3 (N 3:P = 1:1 blends, no sand)	...	0.38	0.13	...	0.29
Mortars					
N 1 1:3	0.11	0.22	0.17	...	...
N 2 1:3	0.06	0.12	0.12	0.12	...
N 3 1:3	...	0.38	0.13	...	...
M 1 1:3	0.14	0.11	0.10	0.07	...
M 2 1:3	0.12	0.20	0.18	0.15	0.131
H 1 1:3	0.13	0.09	0.13	0.09	...
H 2 1:3	0.73	0.07	0.01	0.09	...
H 3 1:3	...	0.18	0.04	0.07	...
P:LI (1:2.9)	5.50, 6.0	8.12,[g] 8.3	11.2	...	...
(1:1:6)	6.7	3.2	...	...	...

[a] Natural masonry cements.
[b] Type I portland cement.
[c] A masonry cement based on portland-limestone.
[d] Masonry based on portland-lime-limestone.
[e] Hydraulic limes.
[f] An Ohio dolomitic lime, normally hydrated.
[g] Cracks, unsound.
[h] Small cracks on trowelled side.

TABLE II.—AUTOCLAVE EXPANSION OF CONCRETE AND MORTAR OF VARIOUS AGES, FABRICATED FROM A NATURAL CEMENT.

Date of Fabrication	Specimen	Source	Expansion, per cent	
			Volume	Linear
1825–1828	concrete with red aggregate	canal locks	4.00	1.014
1850	concrete with gray aggregate	beach	3.44	1.30
1870	concrete with red aggregate	Brooklyn Bridge	0.7	0.23
1890	concrete with gray aggregate	old concrete	1.49	0.50
1892	neat old type briquet	laboratory specimen	0.64	0.21
1920	neat new style briquet	laboratory specimen	0.65	0.22
1938	neat new style briquet	laboratory specimen	1.05	0.34
1949	neat new style briquet	laboratory specimen	1.26	0.42
1938	sand briquet	laboratory specimen	0.45	0.15
1938	sand briquet	laboratory specimen	0.30	0.10
1946	sand briquet	laboratory specimen	2.3	0.76
1952	sand briquet	laboratory specimen	0.30	0.10
1952	sand briquet	laboratory specimen	1.40	0.47
	mortar from a brick pier, no age given, about 4 in. thick		2.25	0.75
	N 1 neat cement at 48 hr	...	...	10.00

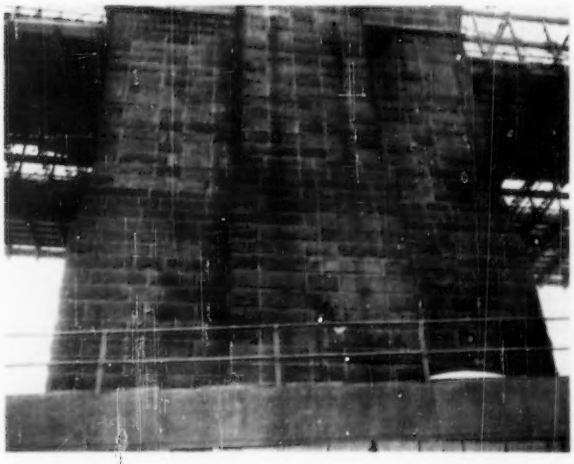

Fig. 2.—Brooklyn Bridge Masonry Built with Natural Cement, N 1.

While the neat cement expands 10 per cent in the autoclave, this masonry shows no evidence of expansion.

The mortar expansions are of a different order from those of neat cement specimens. Sometimes the mortars expand more after 7 days than at 2 days, apparently because of increased rigidity, despite continuing hydration of the MgO in the interim.

Webb (2) found more expansion in masonry walls built with the addition of portland cement than in its absence, suggesting greater early rigidity as the cause of the increase.

A collection has been made of mortar and concrete specimens made of natural cement N, ranging in age up to about 100 yr. A few old briquets were found in the cement laboratory.

These specimens were stored under water for seven days. Their volume was determined by weighing in air and under water. They were given the standard autoclaving and after cooling under water, the volume was again measured. The results are given in Table II.

None of the structures represented by the samples show evidence of unsoundness. Figure 2 is a photograph of a Brooklyn Bridge pier after about 80-yr exposure to the weather.

These expansions suggest that some reactions are occurring in the autoclave other than hydration of MgO, which should have been completely hydrated in some of the older structures.

On the basis of this work, the authors believe that a limit as drastic as 1 per cent maximum autoclave expansion as proposed by McBurney (1) should not be adopted until more experimental evidence indicates that it is critical.

II SAND GRADING AND SHRINKAGE IN MORTAR AND CONCRETE

C. C. Connor has proposed (3) an hypothesis that "shrinkage cracking" in brick masonry is greatly influenced by the fineness of the sand used in the mortar. He feels that the use of more than 25 per cent passing a No. 50 sieve is dangerous. The senior author in discussing this paper, showed photographs of definite cracking as distinguished from any "result of the mason's technique" (4).

To shed further light on the shrinkage, a series of commercial New Jersey sands was investigated in mortars. The sieve analyses of these sands are given in Table III. Mortar prisms were fabricated in metal molds 1:3 (by volume) with the sand measured damp and loose. Two consistencies were used which permitted the penetration of a ½-in. aluminum rod weighing 100 g.

[2] Tentative Specification for Flow Table for Use in Tests of Hydraulic Cement (C 230 - 52 T), 1952 Book of ASTM Standards, Part 3, p. 34.

with a bullet-shaped end to depths of ¼ in. and 2 in., which corresponded to 80 and 110 per cent flow after 25 drops.[3] Concrete prisms were also made using a 1:2.5:3.5 mix by volume, with trap rock passing a ¾-in. sieve for the coarse aggregate and with 0 to ¼ in. or 4 to 6-in. slumps. Two-inch cubes were also fabricated.

The specimens were stripped after standing 24 hr in the damp closet. They were stored wet for 6 days and then in the air at 73 F and 50 per cent relative humidity. After 28 days half the specimens were immersed in water for 48 hr and dimensions measured to 0.001 per cent, after which they were brought to constant weight at 122 F over solid calcium chloride to determine the moisture movement. The moisture movements are given in Table IV.

The moisture movements of the mortar specimens made from different sands do not vary much beyond the experimental error for any one set of conditions. However, when the total shrinkage in the laboratory air at room temperature over the period of 7 to 90 days is plotted against the percentage of sand passing a No. 50 sieve (Fig. 3), the finer the sand the greater the shrinkage. Neither the expansion on soaking nor the shrinkage on drying at 122 F has shown any relationship with sand fineness in these experiments. In concrete, these sands failed to show the same relationship to shrinkage in the laboratory air, and furthermore the movements were smaller than in mortars. The addition of more water to any one mix has usually resulted in greater movement, which seems to increase with the volume of paste (cement plus water). It is known that the greater the amount of water the greater the amount of cement hydrated, and it is the hydrated cement paste

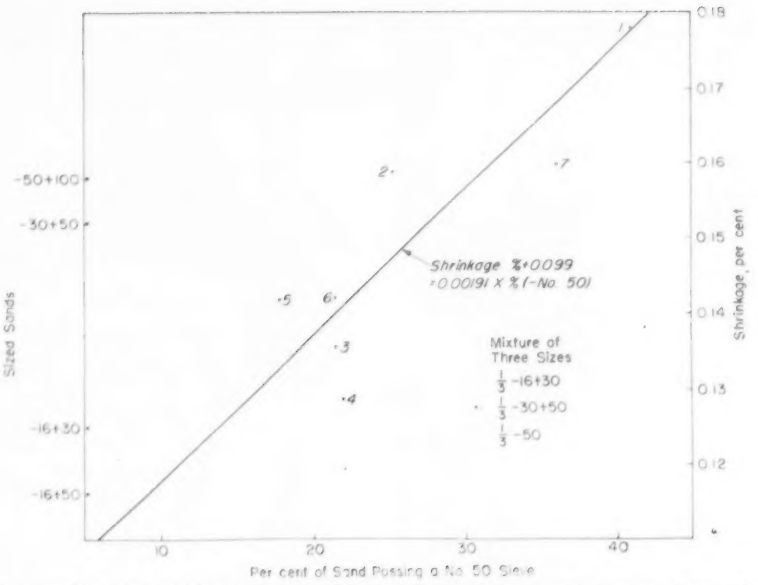

Fig. 3.—Shrinkage of Mortar Seems to Increase Proportionally to the Amount of Fines in the Sand.

TABLE III.—SIEVE ANALYSES OF SANDS.

Fractions, per cent	Sieve analyses, per cent					
	Retained on Sieve No. 8	Retained on Sieve No. 16	Retained on Sieve No. 30	Retained on Sieve No. 50	Retained on Sieve No. 100	Passing Sieve No. 100
Commercial Sands						
1 New Jersey	0.4	3.6	12.3	32.3	35.0	16.0
2 New Jersey	4.7	9.9	20.4	39.7	20.7	4.5
3 New Jersey	2.4	16.4	29.5	35.3	12.3	4.1
4 New Jersey	8.6	21.0	23.7	25.0	15.4	6.3
5 New Jersey	7.5	19.6	24.0	31.2	14.2	3.5
6 New Jersey	2.6	20.9	27.1	28.0	16.4	5.0
7 New Jersey	2.7	9.7	17.6	34.0	30.7	5.5
8 New Jersey	12.0	14.0	16.0	28.7	23.2	6.1
9 New York	1.2	16.6	34.6	36.4	7.7	0.6
Special Sand Gradings						
20	...	...	...	100	...	...
21	...	...	100	...	...	...
22	...	...	...	...	100	...
23	...	...	50	50	...	...
24	...	...	34	33	33	...
25	31.3[a]	17.8	14.7	12.2	10.3	13.8
26	46.0[b]	13.5	11.2	9.3	7.9	11.5

[a] Continuous grading, $r = 1.2$ with 7 per cent on No. 4.
[b] Continuous grading, $r = 1.2$ with 29.7 per cent on No. 4.

TABLE IV.—MEAN MOISTURE MOVEMENTS WITH VARIOUS SANDS.

	Water Cement Ratio, gal. per bag	Consistency	Initial Shrinkage at 21 days, per cent	σ	Wet Expansion, per cent	σ	122 F Shrinkage, per cent	σ	Shrinkage 28 to 90 days, per cent	σ	122 F Ratio, Loss, per cent	σ
Commercial Sands												
A[a] 1:3	5.6	stiff	0.081	0.009	0.049	0.009	0.078	0.008	0.050	0.006	7.2	0.006
B[a] 1:3	6.8	soft	0.112	0.027	0.055	0.009	0.087	0.009	0.054	0.007	9.3	0.012
C[b] 1:2.5:3.5	8.8	stiff	0.051	8	0.029	0.008	0.049	0.005	0.020	0.004	6.8	0.007
D[b] 1:2.5:3.5	10.8	soft	0.056	8	0.031	0.008	0.054	0.004	0.026	0.002	8.3	0.004
Special Gradings												
A[a] 1:3	6.7	stiff	0.088	0.018	0.02	0.006	0.084	0.011	0.019	0.004	9.0	0.013
B[a] 1:3	7.6	soft	0.117	0.017	0.055	0.008	0.092	0.011	0.036	0.004	10.5	0.013
C[b] 1:2.5:3.5	9.5	stiff	0.066	0.014	0.038	0.012	0.054	0.005	0.040	0.004	8.3	0.008
D[b] 1:2.5:3.5	11.3	soft	0.060	0.009	0.035	0.005	0.060	0.005	0.015	0.011	9.0	0.008

[a] Mortar specimens.
[b] Concrete specimens.

that provides the shrinking as it dries out. At the same time, with the increase in void space, the resistance to shrinkage is reduced.

Based on these findings an explanation of shrinkage-cracking in masonry might be offered: the initial shrinkage has a magnitude sufficient to produce incipient cracks between the bricks and mortar provided the total flexibility in the masonry (to which the units may contribute) is insufficient to adjust itself to the strains. These results support Mr. Connor's hypothesis that fines in sand contribute to cracking in *masonry*. This phenomenon is receiving further experimental study.

The compressive results obtained with 2-in. cubes stored wet 7 days and then in the air 21 more days are given in Fig. 4, where cement-water ratios are plotted against compressive strengths. The reason for using this ratio instead of the usual water-cement ratio is that strength increases with cement content and decreases with voids, which are produced mostly by water, where no air-entraining agent is used. A straight-line relation (Fig. 4) is obtained here with a very small standard deviation of 50 psi fitting the equation:

$$\text{Compressive strength} = 47{,}000(c/w - 0.26)$$

III MOISTURE MOVEMENTS IN CONCRETE MADE FROM BLENDED CEMENTS

It has been suggested that blends of natural cement with portland cement should control the cracking in concrete, and experience has been reported in which raw mix, added to concrete was said to have prevented cracking. In order to measure shrinkage and moisture movement of various blends in concrete, a 1:2.5:3.5 mix by volume was used to fabricate 2-in. cubes and prisms. The means of length changes for all the blends for a given cement factor and consistency are reported in Table V together with the standard deviations.

The prisms were first stored wet for 7 days and then in air at 50 per cent relative humidity and close to 73 F for 21 more days. They were immersed for 48 hr and dried over solid calcium chloride at 122 F to constant weight. Part of the prisms were allowed to continue shrinking without any wetting. Two additional months of drying produced a shrinkage of only a very few more parts in 100,000 (Table V).

Compressive Strengths.—If the compressive strengths of the blends are plotted against the *cement*-water ratios, a straight line, adjusted by least squares, may be drawn through the points (Fig. 5). This line intersects the abscissa to the right of the origin and may be defined as follows:

$$C = 44{,}000(c/w - 0.040)$$

(with a standard deviation of about 400 psi, Fig. 3)

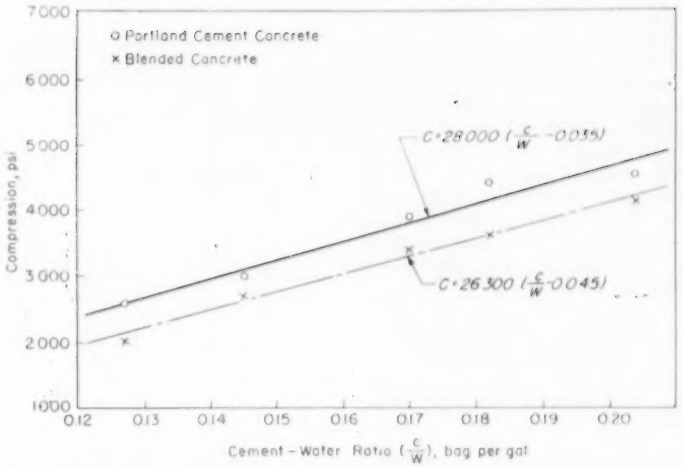

Fig. 4.—Compressive Strength of Concrete Seems to be Proportional to the Ratio of the Cement to the Water.

The lower line is for blended cement concrete, and the upper line gives the unblended portland concrete results.

TABLE V.—MOISTURE MOVEMENT OF CEMENT BLENDS.

Mix	Cement Factor	Consistency	Initial Shrinkage 21 Days, per cent	σ	Wet Expansion at 48 hr, per cent	σ	122 F Shrinkage, per cent	σ	Shrinkage 28–90 Days, per cent
Unblended Portland Cement with Four Sands									
A	8	Stiff[a]	0.049	0.007	0.029	0.005	0.035	0.006	0.001
B	8	Soft[b]	0.065	0.010	0.031	0.007	0.037	0.009	0.005
C	6	Stiff	0.047	0.008	0.027	0.004	0.030	0.011	0.004
D	6	Soft	0.059	0.012	0.032	0.004	0.033	0.006	0.004
E	4	Stiff	0.041	0.005	0.020	0.003	0.033	0.005	0.006
F	4	Soft	0.044	0.010	0.032	0.005	0.032	0.004	0.003
		Avg.	0.051	0.009	0.029	0.005	0.033	0.007	0.004
Blends with Four Materials, Replacing 10, 20, and 30 per cent									
A	8	Stiff	0.055	0.010	0.029	0.005	0.044	0.008	0.006
B	8	Soft	0.063	0.009	0.033	0.006	0.050	0.009	0.008
C	6	Stiff	0.042	0.016	0.028	0.003	0.045	0.005	0.005
D	6	Soft	0.047	0.015	0.031	0.003	0.045	0.005	0.004
E	4	Stiff	0.053	0.999	0.026	0.004	0.043	0.005	0.004
F	4	Soft	0.060	0.012	0.031	0.009	0.047	0.009	0.005
		Avg.	0.053	0.012	0.030	0.005	0.046	0.007	0.005

[a] Stiff—means slump from 0 to 1 in.
[b] Soft—means slump from 4 to 6 in.

Neither the initial shrinkage nor the moisture movement were appreciably affected by the blending. The volume of the cement paste seemed to be the most important factor in determining the magnitude of these movements. Compressive strengths of the blended cement concretes were proportional to the cement-water ratios within a small range. The improved performance of Indiana pavements has been ascribed (5) to the enhanced flexibility of the blended concrete.

References

(1) J. W. McBurney, *Proceedings*, Am. Soc. Testing Mats. Vol. 52, p. 1228 (1952).
(2) T. L. Webb, *Proceedings*, Am. Soc. Testing Mats., Vol. 52, p. 1255 (1952).
(3) C. C. Connor, *Proceedings*, Am. Soc. Testing Mats., Vol. 53, p. 933 (1953).
(4) F. O. Anderegg, *Proceedings*, Am. Soc. Testing Mats., Vol. 53, p. 945 (1953).
(5) Sanford Benham, *Proceedings*, 37th Annual Road School, Purdue University (1951).

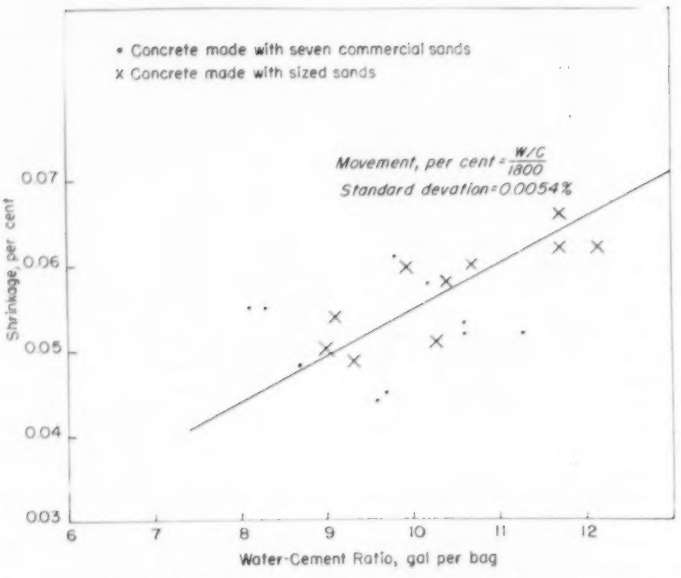

Fig. 5.—On Plotting the Shrinkage Against Water-Cement Ratio, a Straight Line Can be Drawn Through the Points, Having the Equation, Movement, per cent = W/C/1800.

DISCUSSION

MR. C. C. CONNOR.[1]—I am much gratified that the authors found confirmation of the evidence presented in my paper[2] that a sand having a high percentage passing the No. 50 sieve increased the shrinkage in mortar. I am surprised, however, that the same increase in shrinkage was not found in concrete because my observations have indicated a similar effect.

The data on the cracking of concrete in buildings under my personal observation are not so well compiled as they should be for scientific proof, but there is no question that the cracking of concrete in basement floor slabs and walls is consistently high where the sand has an excess of particles passing the No. 50 sieve. Furthermore, where the sand is known to have less than 25 per cent passing the No. 50 sieve, and also has fractions between sieves which increase progressively from coarse to fine up to and including the fraction between the Nos. 30 and 50 sieves, wide cracks in the concrete are infrequent and the surface crazing is usually much reduced.

The growing amount of evidence indicating the influence of the gradations of sand on concrete cracking justified a test at a recent building where the head of water was $5\frac{1}{2}$ ft on part of the basement slab and $3\frac{1}{2}$ ft on the remainder. The basement slab was 79 ft by 90 ft and there were no movement joints. A concrete sand was selected which had less than 25 per cent passing the No. 50 sieve and also had fractions between sieves which increased progressively from coarse to fine up to and including the fraction between the Nos. 30 and 50 sieves, as had been found desirable for mortar. At the age of 23 months, no cracks sufficient to cause leaks had occurred in the concrete.

Perhaps the most impressive evidence concerning the influence of the sand grading on the cracking of basement concrete comes from a large group of buildings in the Long Island area. Sieve analyses of sands from that area have almost invariably shown that the grading of these sands has similar characteristics to that used in the test building previously described. An inspection of five buildings in this group disclosed only one wide crack and a minimum of surface crazing. The wide crack had caused a leak. Reliable reports covering many more buildings in this group showed that the leak observed was the only one that had occurred, although water pressure on the basement slabs and walls is quite common. The general statement was made that the cracking of concrete in these buildings had not been a problem of importance.

The construction of the buildings in this group was similar in many respects to those in the group which have been under my periodic observation. The buildings in both groups were designed by the same architects and for the same purpose. The specifications for concrete have changed at times but have been similar in like periods. The inspection during construction was comparable, and several buildings in each group were built by the same contractor. The only obvious reason for the wide difference in concrete cracking that has so frequently occurred is the difference in the grading of the sand used.

Undoubtedly there are other factors in the cracking of concrete, but it appears that a further study of the effect of sand grading upon concrete shrinkage should prove very profitable. The evidence is strong that the sand grading exerts an important influence upon the cracking of concrete and there seems to be real hope that the use of sand having a proper grading would inhibit or greatly reduce the shrinkage of concrete if the other conditions were reasonably well controlled.

[1] Building Inspection and Maintenance Engineer, New Jersey Bell Telephone Co., Newark, N. J.

[2] C. C. Connor, "Some Effects of the Grading of Sand on Masonry Mortar," *Proceedings*, Am. Soc. Testing Mats. Vol. 53, p. 933 (1953).

MR. BRYANT MATHER.[3]—Mrs. Mather in her 1952 paper on light microscopy[4] and in her 1953 paper on crushed limestone aggregates[5] reported the results of the petrographic examination of concrete from several mass concrete structures. A correlation was found between the amount of material finer than the No. 200 sieve in the aggregate and cracking of the structure which in turn correlated somewhat with the modulus of elasticity. With more material finer than the No. 200 sieve there was a higher elastic modulus and more cracking. It also appeared that the crystalline calcium hydroxide from the hydration of the cement was in smaller crystals. The net effect seemed to be that, where there was a smaller amount of fines in the aggregate, there were larger areas of apparently amorphous cement paste, a lower elastic modulus, and less cracking in the concrete.

[3] Engineer, Concrete Division, Waterways Experiment Station, Corps of Engineers, Jackson, Miss.

[4] Katharine Mather, "Applications of Light Microscopy in Concrete Research," Symposium on Light Microscopy, Am. Soc. Testing Mats., p. 51 (1952). (Issued as separate publication *ASTM STP No. 143.*)

[5] Katharine Mather, "Crushed Limestone Aggregates for Concrete," *Mining Engineering*, Am. Inst. Mining and Metallurgical Engrs. Tech. Publ. 3616 H, Oct., 1953, p. 1022.

Bookshelf

(Continued from page 34)

The Testing and Inspection of Engineering Materials, 2nd Ed.

H. E. Davis, G. E. Troxell, and C. T. Wiskocil; McGraw-Hill Book Co., Inc., New York, N. Y.; 431 pp.; $6.50.

THIS book develops the concepts and principles of materials testing, discusses the many types of tests in current use, describes the equipment used for these tests, and covers the effect of the many variables upon the test results obtained. One of the principal aims of the book is to stress the nature of physical measurements and tests and to indicate the limitations of data derived from them. Precautions necessary to secure reliable test data and the influence of important variables on test results are indicated. Variability in measurements and materials is repeatedly pointed out, and a basis is laid for the planning of tests so as to give results within prescribed limits of error.

This second edition includes material on various new procedures, testing machines, and special testing devices, such as microhardness testers. Various new types of nondestructive tests, such as the use of ultrasonics and penetrants for detecting defects, are described. The material on electrical strain gaging has been considerably amplified. The technique of brittle coatings in stress analysis is adequately covered. Low-temperature impact tests and true stress—natural strain relations have been included because of their increasing significance. Many new figures have been added and new problems on columns, beams, helical springs, and electrical strain gages have been included.

American Standard on Butt-Welding Ends (ASA B16.5—1955)

American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.; $1.

IN 1953, the American Welding Society presented its proposal on Welding End Preparations to ASA Sectional Committee (B16) on Pipe Flanges and Fittings with the recommendation that it be considered as material for an American Standard. This proposal was expanded to include welding and preparations for valves and flanges as covered by the American Standard Steel Pipe Flanges and Flanged Fittings (B16.5) and the American Standard Steel Butt-Welding Fittings (B16.9). Also taken into consideration was the Pipe Fabrication Inst. Standard ES-1.

After two years of effort, which included the preparation of three draft documents, the approval of the Sectional Committee as well as the sponsor organizations (American Society of Mechanical Engineers, Heating and Piping Contractors National Assn., Manufacturers Standardization Society of the Valve and Fittings Industry) was obtained. The final approval of the American Standards Assn. was granted on September 14, 1955.

Reinforced Grouted Brick Masonry Field Inspectors Handbook

Clay Brick and Tile Assn., San Francisco, Calif.; paperbound.

IN THE western earthquake area of the United States, particularly in California, it has been necessary, in brick masonry wall construction to use reinforcement of some kind. A relatively new and different type of construction is that known as Reinforced Grouted Brick Masonry, combining brick, mortar, grout, and reinforcing steel.

This system, known as RGBM, has changed not only the design of the building itself, as seen in high-strength piers, beams, and walls, but has also changed the art of brick construction. It is necessary to discard many of the common methods and techniques used by the masonry craftsmen, such as lightly buttered head joints and furrowed bed joints. Many of the artisans have been reluctant to accept the new methods and the inspector's job has increased in responsibility because of the need for insuring that proper methods are used.

This small, compact handbook should be very valuable and useful to engineers and inspectors. It contains a group of definitions of commonly used terms; sections on absorption of brick, construction joints, efflorescence, grout, masonry mortar, reinforcing steel, test specimens, inspection, and reference to building codes and ASTM standards. Simple illustrations should be very helpful in showing the inspector the desired conditions.

Abstracts of the Literature on Semiconducting and Luminescent Materials and Their Application—1954

The Electrochemical Society, Inc., John Wiley and Sons, Inc., New York, N.Y.; 200 pp.; paperbound, $5.

THIS compilation of abstracts, issued annually, serves a very useful purpose in bringing together in one place abstracts of papers appearing in many periodicals throughout the world. Such a service is very important to the continued healthy growth of this interesting and important new field.

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PROFESSIONAL CARDS

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PERSONALS...

News items concerning the activities of our members will be welcomed for inclusion in this column

Many ASTM members are active as officers of the American Council of Independent Laboratories, Inc. At the annual Convention held in Phoenix, Ariz., in November, **Lewis F. Herron,** President of the James H. Herron Co., Cleveland, Ohio, was re-elected President of ACIL. Other re-elected officers included **Alvin Purdy,** Bull & Roberts, Inc., New York City, Vice-President; **Roger W. Truesdail,** Truesdail Laboratories, Inc., Los Angeles, Secretary; and **F. H. Wright,** Lucius Pitkin, Inc., New York City, Treasurer. **Cecil Shilstone,** Shilstone Testing Laboratory of New Orleans, was elected to a three-year term on the Executive Committee. A special feature of the convention was a Seminar on "Foundation Soil Testing" emphasizing the importance of adequate soil investigations and tests before buildings are designed or roads laid. Architects, engineers, and contractors throughout Arizona were guests of the Council for the seminar. Chairman of the panel was **Claude E. McLean,** President, Arizona Testing Laboratories of Phoenix. Members of the panel included **John Gislason,** Twin City Testing and Engineering Laboratory, St. Paul, Minn.; **C. A. Lashbrook,** Oklahoma Testing Laboratories, Oklahoma City; **Morris Miller,** A. W. Williams Co., Mobile, Ala., and **Jay Evans,** Law-Barrow-Agee Laboratories, Atlanta, Ga.

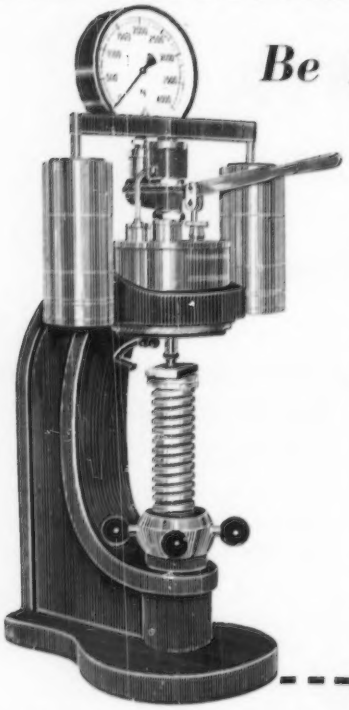
The following were among seven men elevated to honorary membership in The American Society of Mechanical Engineers in 1955, the Society's 75th anniversary year: **Joseph Bradley Armitage,** Vice-President in Charge of Engineering, Kearney & Trecker Corp., Milwaukee, Wis.; **Carl George Arthur Rosen,** Consulting Engineer, Caterpillar Tractor Co., Peoria, Ill.; and **Philip Sporn,** President, American Gas & Electric Co., New York City.

At the University of Pennsylvania's recent observance of its 100 years of engineering instruction, the following were among 23 alumni of its engineering schools who received "Centennial Citations" for professional achievement, contribution the public welfare, and service to their alma mater: **Hugh W. Field,** Director and Vice-President of Research and Development, The Atlantic Refining Co., Philadelphia, Pa.; **Albert T. Goldbeck,** Engineering Director of the National Crushed Stone Assn., Washington, D. C.; **Jonathan Jones,** retired Chief Engineer of the Bethlehem Steel Co., Bethlehem, Pa.; **Adolph O. Schaefer,** Vice-President-Executive Assistant, The Midvale Co., Philadelphia, Pa.; and **Francis G. Tatnall,** Director of Research and Development, Baldwin-Lima-Hamilton Corp., Philadelphia. All these men have been active in the work of ASTM; Messrs. Goldbeck, Schaefer, and Tatnall are former Directors, and Mr. Goldbeck is also an Honorary Member of the Society.

A. C. Ahlston recently retired as Chief Mechanical Engineer, Victorian Railways, Melbourne, Australia. He had been a member of ASTM since 1931. He is succeeded by **G. F. Brown** who is now assuming membership in the Society.

William M. Akin, President, Laclede Steel Co., St. Louis, Mo., was elected Vice-President of the American Iron and Steel Inst. by the board of directors.

(Continued on page 72)



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(*Continued from page 71*)

Lucius D. Barrows, Chief Engineer of the Maine State Highway Department at Augusta, has retired after 45 years in the service of the State. When Mr. Barrows went to the department in 1910 it was only five years old. He has been Chief Engineer since 1928. He will be succeeded by **Vaughan M. Daggett,** of Augusta, who has been Assistant Chief Engineer since 1951.

K. M. Bartlett, formerly Director of Research, Thompson Products, Inc., Cleveland, Ohio, is now Executive Vice-President, Horizons, Inc., in the same city.

Thomas A. Berrigan has retired as Director and Chief Engineer, Massachusetts Sewerage Division, Metropolitan District Commission, Boston. He will continue as chairman of the Merrimack Valley Sewerage Board. Mr. Berrigan who represented the Division membership in ASTM for many years, served from 1951 to 1955 on the New England District Council. He has opened an office as consulting engineer and attorney-at-law in the Statler Building, 20 Providence St., Boston.

Alfred L. Boegehold, Assistant to the Vice-President in Charge of General Motors Research Staff, Detroit, Mich., was awarded the 1955 Gold Medal of the American Society for Metals "in recognition of his great versatility in applying science to the metal industry."

Raymond K. Bowden, Director of Quality Surveys, United States Steel Corp., Pittsburgh, Pa., was one of the recipients of professional engineering degrees this year from Ohio State University "in recognition of engineering ability and accomplishments of a high order."

G. H. Clamer, of the Ajax Metal Division of H. Kramer and Co., Philadelphia, Pa.; Past-President of the Society and Honorary Member, was honored on his 80th birthday with a luncheon at the Waldorf-Astoria, New York City, given by the Brass & Bronze Ingot Inst. He continues particularly his ASTM interest in Committee B-5 on Copper and Copper Alloys, where he is chairman of the group concerned with castings and ingots for remelting. Dr. Clamer pioneered in the chemical phases of the non-ferrous industry and in the electric melting of non-ferrous metals.

George F. Clark, formerly with Chemo-Textiles, West Warwick, R. I., is now Superintendent, Dodge Fibers Corp., Hoosick Falls, N. Y.

Victor Conquest, Vice-President, Armour & Co., Chicago, Ill., has been named to receive the Industrial Research Inst. Medal for 1956. The medal has been awarded annually since 1945 to honor "outstanding accomplishment in leadership in or management of industrial research which contributes broadly to the development of industry or the public welfare." Mr. Conquest was also winner of the Nicholas Appert Medal in 1953.

John C. Coonley has been elected President and Member of the Board of the Hydraulic Press Mfg. Co., Mount Gilead, Ohio. Until January of this year Mr. Coonley was General Manager of the Valve Division, A.C.F. Industries, Detroit, Mich.

The 80th birthday of **Harvey L. Curtis,** longtime member of the staff of the National Bureau of Standards, Washington, D. C., and well known to the membership of ASTM, was celebrated on December 14 by his many associates in Science and Engineering at the Bureau. Dr. Allen V. Astin, NBS Director, presented him with a bound volume of letters from many of his former scientific associates extending congratulations. Dr. Curtis is an Honorary Member of ASTM, as well as of its Committee D-9 on Electrical Insulating Materials (of which he was chairman, 1930–34), in recognition of valued services to the Society. Internationally known for his work in absolute electrical measurements, Dr. Curtis until his retirement in 1946 was Chief of the Bureau's Inductance and Capacitance Section, of the Electricity Division. In addition to the basic work on absolute electrical measure-

(*Continued on page 73*)

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ments, he inaugurated fundamental researches on the properties of dielectrics, particularly rubber and petroleum. During World Wars I and II he directed extensive programs in ballistic research for the Navy. Since his retirement he has maintained an active association with the Bureau and has continued interest in ballistics, electrical measurements, and science education, publishing several scientific and historical papers in recent years. Dr. Curtis founded the unique organization of retired Government workers "The Fossils" who hold weekly meetings for fellowship and discussions of subjects of mutual interest.

Wayne Deringer, former Director of Ceramic-Organic Research at A. O. Smith Corp., Milwaukee, Wis., has been appointed an Associate Director of Research.

Edward J. Dulis, formerly with United States Steel Corp., Monroeville, Pa., is now Supervisor, Crucible Steel Company of America, Research and Development Lab., Pittsburgh, Pa.

Francis C. Frary, retired Director of Research, Aluminum Company of America, received the Guido Donegani Gold Medal of the Associazione Italiani di Metallurgia in Milan, Italy, in October. The medal is given every two years to one whose work has especially contributed to the development of scientific knowledge on aluminum or to the improvement of metallurgical and technological knowledge.

Jacob K. Frederick, formerly Associate Professor, has been advanced to the status of full Professor, and appointed chairman of the Division of Textile Manufacturing at Lowell Technological Institute, Lowell, Mass. Besides his teaching and department head duties, he is Technical Director of the Testing Section of the LTI Research Foundation. In ASTM he serves on Committee D-13 on Textile Materials and as chairman of Subcommittee A-2 on Man-made Organic-Base Fibers and Their Products.

Delmond L. Getz, formerly with The Steel Products Engineering Co., Springfield, Ohio, is now on the engineering staff of Airesearch Manufacturing Co., Phoenix, Ariz.

Jesse R. Gilbert is now Consulting Engineer, Birmingham Slag Co., Birmingham, Ala. He was previously Chief, Concrete Control Branch, U. S. Department of the Army, Office, Chief of Engineers, Washington, D. C.

Paul D. Gorsuch, formerly Metallurgical Engineer, Materials and Processes Laboratory, General Electric Co., Schenectady, N. Y., is now serving on the staff of the GE Research Laboratory at The Knolls, Schenectady, as Research Associate in the Metallurgy and Ceramics Dept.

(*Continued on page 74*)

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- Molds for various ASTM tests.
- Water Retention Apparatus (ASTM C91)
- Transverse Beam Test Apparatus (ASTM C78)
- Concrete Beam Testers (ASTM C91)
- Slump Cones (ASTM C143)
- Dial Micrometers (ASTM C151)
- Los Angeles Abrasion Testers (ASTM C131)
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(*Continued from page 73*)

Ralph M. Hardgrove has been named as 1955 recipient of the Percy Nicholls Award for his outstanding contributions to the science and technology of solid fuels. The award was given at the Solid Fuels Conference sponsored jointly by the AIME and ASME. Mr. Hardgrove is associated with the Research Division, Babcock & Wilcox Co., Alliance, Ohio. One of his developments is the Hardgrove grindability test, accepted by ASTM as the standard method of determining the grindability of coal.

J. C. Harris, Director, Application Research Dept., Monsanto Chemical Co., Dayton, Ohio, was selected by the Chemical Specialties Manufacturers' Assn. as recipient of its 1955 Achievement Award. The award was presented at the Association's annual meeting in New York City on December 6, in recognition of Mr. Harris' contributions to the evaluation of detergents and establishment of industry standards for surface-active agents.

Frederick P. Hesch, formerly with Northrop Aircraft, Inc., Hawthorne, Calif., is now Production Engineer, Aerojet-General Corp., La Habra, Calif.

Samuel L. Hoyt, Metallurgical Consultant, Columbus, Ohio, received an honorary Sc.D. degree from the South Dakota School of Mines and Technology.

Harry F. Irwin is now Concrete Engineer, Warner Co., Philadelphia, Pa.

Leo Ivanovszky, formerly Managing Director, Abril Corp. (Gr. B.) Ltd., Bridgend, England, is now Chemical Consultant and Lecturer, Borough Polytechnic, in London.

Duane R. Keller, until recently Research Engineer, U. S. Department of the Army, Research Div., Ordnance Missiles Lab., Redstone Arsenal, Huntsville, Ala., is now on the faculty of the University of Akron as Professor and Head of the Department of Civil Engineering.

William A. Kennedy, Supervisor of Products, Grinnell Co., Providence, R. I., was awarded the 1955 McCrea Medal by the Malleable Founders' Society, for outstanding service to the malleable iron castings industry. As chairman of the Technical Council of Malleable Founders' Society for the past eight years, Mr. Kennedy has led in the technical work of the industry. Among the constructive projects carried to completion by his group were ones dealing with "Gating and Feeding of Malleable Castings" and "Malleable Core Materials and Practices." In addition he has done considerable work of his own on speed of testing, high- and low-temperature properties, and impact testing. He also is a member of a committee engaged in revising the Malleable Iron Handbook. An active ASTM member, he has been chairman of Committee A-7 on Malleable-Iron Castings since 1946. He also is a member of the Advisory Committee on Corrosion, Committee A-3 on Cast Iron, and other groups.

Jack Knight, formerly with the Utah Construction Co., Richmond, Calif., is now Chief Draftsman with William Lumpkins, Architect, La Jolla, Calif.

Edward W. Larson, Jr., until recently associated with Hughes Aircraft, Los Angeles, Calif., is now Research Engineer, Lockheed Aircraft Co., Burbank, Calif.

Walter Lovett has been appointed manager of the recently created Technical Service Department of Pittsburgh Corning Corp., Pittsburgh, Pa., established to provide prompt technical assistance to customers for its products, PC Glass Blocks and Foamglas.

James Tucker MacKenzie, Technical Director, American Cast Iron Pipe Co., Birmingham, Ala., was chosen to receive the 1955 Southern Chemist Award, given annually in recognition and honor of distinguished service to the profession of

(*Continued on page 76*)

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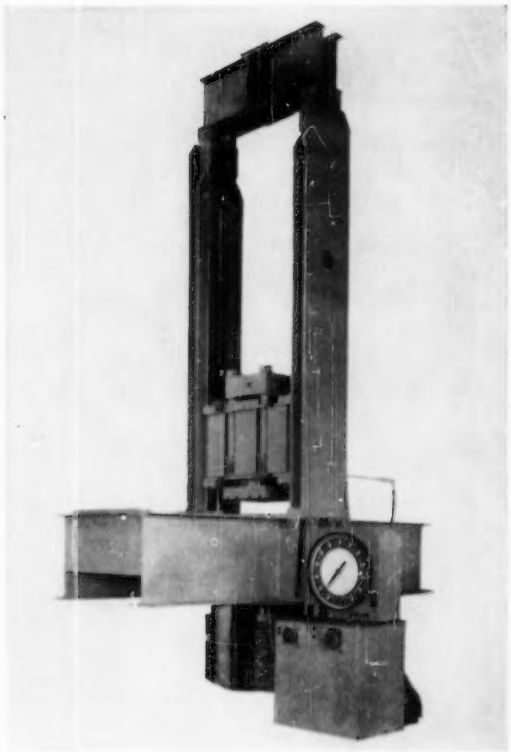

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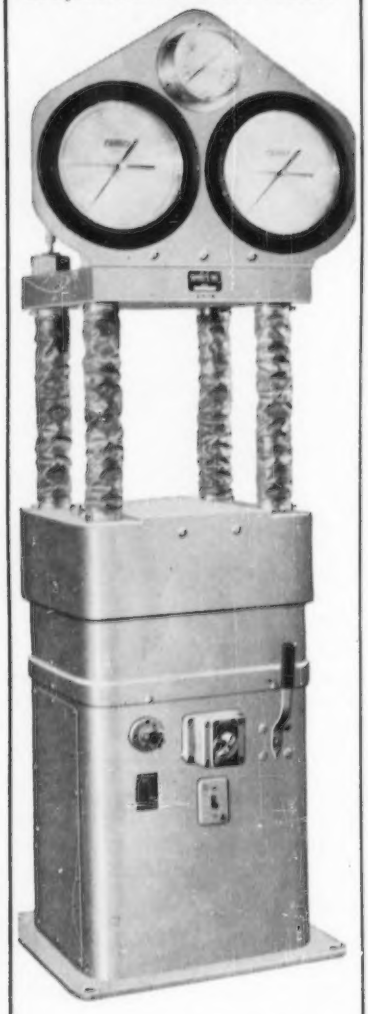

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(*Continued from page 74*)

chemistry in the South. The selection of Mr. MacKenzie was made in recognition of his important researches and writings in metallurgical chemistry and in appreciation of his years of service in the offices and committees of his profession.

I. E. Manning retires at the end of the year as Chief Chemist, Bayonne (N. J.) Refinery, Esso Standard Oil Co. Mr. Manning has been interested in ASTM for many years, serving on a number of the technical committees. His home address is 16 Lincoln Parkway, Bayonne, N. J.

Frank A. Marston, Consulting Engineer with Metcalf & Eddy, Boston, Mass., has been elected a Vice-President of the American Society of Civil Engineers.

S. C. Massari, former Technical Director of the American Foundrymen's Society, has been selected to present the Charles Edgar Hoyt Memorial Lecture at the 1956 AFS Convention in Atlantic City, N. J., in May. Also nominated at a recent meeting of the AFS Annual Lecture Committee was **Hyman Bornstein** (formerly with Deere and Co.) who will deliver the Hoyt Lecture at the 1957 convention of the society.

Joseph N. McGowan, formerly with the Pennington Quarry Co., Pennington, N. J., is now President, Trap Rock Industries, Inc., Kingston, N. J.

James P. McNally has been appointed Sales Manager of Bart Mfg. Corp., Belleville, N. J. He was formerly Metallurgical Technical Adviser with the same company, and prior to that time was associated with the Carrier Corp., Syracuse, N. Y.

Albert E. Miller has retired as Assistant to Vice-President and Process Chemist, Sinclair Refining Co., New York City. Representative of the Sustaining Membership of his company for many years, Mr. Miller has participated actively in technical work of the Society since 1925, especially in Committee D-2 on Petroleum Products and Lubricants where he has served on the Advisory Committee and headed certain subgroups. He also has been serving on the Administrative Committee on Standards. He is now assuming personal membership in the Society.

Carleton E. Morrill, formerly with Pepperell Manufacturing Co., is now on the technical staff of Bates Manufacturing Co., Lewiston, Me.

Samuel B. Morris recently was tendered a testimonial luncheon, following retirement as General Manager and Chief Engineer, Los Angeles Department of Water and Power. Mr. Morris, who was described as a "great citizen and a great engineer" has had a distinguished 44-year career in utility operation and education. He will continue to serve the department on a part-time basis. He is succeeded as General Manager by **William S. Peterson.**

James G. Morrow, Metallurgical Engineer, Steel Co. of Canada, Ltd., Hamilton, Ontario; ASTM Past-President, and Past-Chairman of the Canadian Standards Assn., received the ASA Standards Medal, awarded annually for leadership in the development and application of voluntary standards. Presentation was made during the recent Sixth National Conference on Standards in Washington, D. C., sponsored jointly by the American Standards Assn. and the National Bureau of Standards.

Braley S. Myers, who formerly supervised the research programs on metal finishing, surface preparation, metal cleaning, and corrosion in the manufacturing research department of International Harvester Co., Chicago, Ill., has been transferred to the general office of the company as materials engineer.

Robert W. Orr, formerly with the Engineering Dept., Erie Resistor Corp., Erie, Pa., is now on the technical staff of Aircraft Marine Products, Inc., Chemical and Dielectrics Div., Elizabethtown, Pa.

George W. Oxley, a civil engineer whose 36-year career with Esso Research and Engineering Co. centered around materials testing activities and the prevention of corrosion of equipment, recently retired. Mr. Oxley served for some years on ASTM Committee D-11 on Rubber and Rubber-Like Materials.

John I. Parcel, Vice-President of the St. Louis firm of Sverdrup & Parcel, has been elected to honorary membership in the American Society of Civil Engineers. Mr. Parcel has been successful as both a teacher and consultant.

E. S. Pettyjohn, since 1945 Director of the Institute of Gas Technology, affiliated with Illinois Institute of Technology, Chicago, Ill., resigned November 30. Capt. Pettyjohn, with broad operating and research experience in the gas industry, and eight years as a professor of chemical engineering and gas engineering at the University of Michigan, was appointed director of IGT after service with the U. S. Navy. In 1952 he was named Vice-President in recognition of his contribution to the Institute's rise to its present eminent position in the fields of research and education. **Henry R. Linden,** Research Director, will serve as acting director until Capt. Pettyjohn's successor is selected.

F. T. Quinlan recently retired as Engineer of Tests, The New York, New Haven and Hartford Railroad Co., New Haven, Conn. Representative of the company membership in the Society since 1924, Mr. Quinlan served through the years on Committees A-1 on Steel, A-2 on Wrought Iron, A-7 on Malleable-Iron Castings, and D-11 on Rubber and Rubber-Like Materials. He is succeeded as Engineer of Tests by **D. E. Parker,** who now will represent the company in Society and committee activities.

(*Continued on page 78*)

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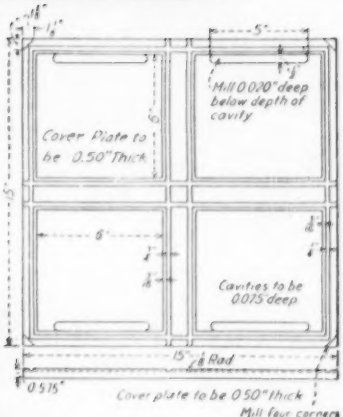
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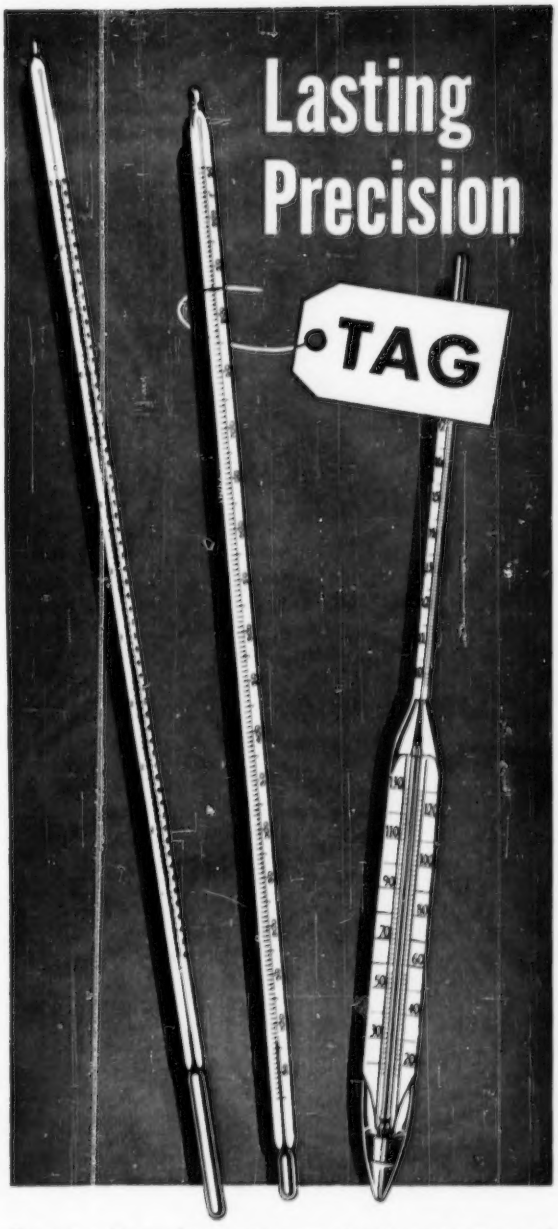

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(*Continued from page 76*)

E. O. Rhodes recently retired as Technical Advisor, Administrative Dept., Koppers Co., Inc., Tar Products Div., Pittsburgh, Pa. Mr. Rhodes, who has represented the company in the Society and on a number of ~~the~~ technical committees since 1921, has assumed personal ASTM membership. He has made valued contributions through the years as a member and chairman of many subgroups of Committees D-4 on Road and Paving Materials, and D-8 on Bituminous Waterproofing and Roofing Materials. Mr. Rhodes' home address is 86 Mayfair Dr., Pittsburgh, Pa.

Walter M. Saunders is now Treasurer, Northampton Cutlery Co., Northampton, Mass.

Mortimer F. Sayre has retired from active teaching at Union College, Schenectady, N. Y., and is now Professor Emeritus of Mechanical Engineering continuing his consulting work and other activities.

Charles E. Schaffner, Professor of Civil Engineering and Assistant Dean, Polytechnic Institute of Brooklyn, has been elected a member of the Executive Committee, Educational Methods Division, American Society for Engineering Education. He also was elected Evening Engineering Education Division representative on the General Council of the Society for a two-year term.

R. K. Scott, formerly Research Engineer, Hall Laboratories, Inc., is now Head, Mineral Identification Group, Harbison-Walker Refractories Co., Hays Laboratory, Pittsburgh, Pa.

Robert S. Shane has been appointed Supervisory Engineer, Commercial Atomic Power Activity, Westinghouse Electric Corp., Pittsburgh, Pa. His duties include programming and implementation of long range major development projects carried on outside CAPA, and assisting with chemical and materials problems incidental to various CAPA projects. Before transferring to the Commercial Atomic Power Activity, Dr. Shane was Supervisory Engineer, Westinghouse Bettis Plant.

Louis G. Sleeper, formerly Research Assistant in Highway Engineering, Department of Civil Engineering, University of Illinois, is now 2nd Lieutenant, Installations Engineer on Operations Staff, Aviation Engineer Force, U. S. Department of the Air Force, Walters Air Force Base, Tex.

Charles O. Smith, until recently associated with E. I. du Pont de Nemours and Co., Inc., Wilmington, Del., is now Staff Member, Oak Ridge School of Reactor Technology, Oak Ridge National Laboratory, Union Carbide Nuclear Co., Oak Ridge, Tenn.

Cyril Stanley Smith has been granted a year's leave from his position as Professor of Metallurgy and Director, Institute for the Study of Metals, University of Chicago. He will reside principally in London and will be occupied in research on the history of science. Support for the work has been given by the Guggenheim Foundation and the U. S. National Science Foundation. En route to London, Dr. Smith attended the International Conference on Peaceful Uses of Atomic Energy at Geneva as an advisory member of the U. S. delegation.

Gale C. Smith, formerly associated with Archer-Daniels-Midland Co., Cleveland, Ohio, is now on the Technical Resin Sales Staff, J. H. Hinz Co., in the same city.

George V. Smith is now Francis Norwood Bard Professor of Metallurgical Engineering at Cornell University, Ithaca, N. Y. For many years he was Research Metallurgist, U. S. Steel Research Laboratory, Kearny, N. J. Professor Smith has participated actively and constructively in the work of the ASTM-ASME Joint Committee on Effect of Temperature on the Properties of Metals, where he has

(*Continued on page 80*)

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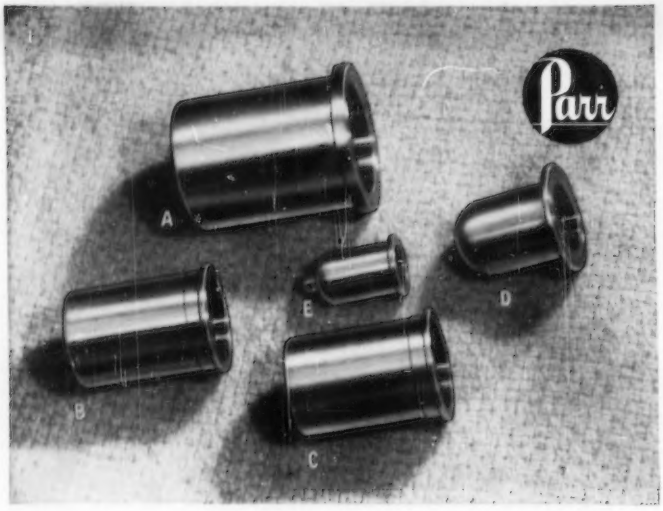

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(*Continued from page 78*)

headed the Data and Publications Panel for some time.

Wiley C. Smith recently retired as Chief Chemist, Engineering Section, Specifications Division, Procurement Division, U. S. Treasury Dept., Washington, D. C. He is now engaged in chemical consulting work in Rustburg, Va. Mr. Smith has served for many years on Committees D-1 on Paint, Varnish, Lacquer, and Related Products, and D-17 on Naval Stores.

Robert P. Stevens, formerly with Wellsville Fire Brick Co., Wellsville, Mo., is now Manager, Refractories Division, Chicago Fire Brick Co., Chicago, Ill.

David Swan has been appointed Director of Research, Metals Research Laboratories, Electro Metallurgical Co., Division of Union Carbide and Carbon Corp., Niagara Falls, N. Y.

H. C. Swett recently was appointed Chief Metallurgical Engineer of Bethlehem Pacific Coast Steel Corp., San Francisco, Calif. He was previously employed as Assistant General Superintendent of the Los Angeles plant of the same company.

Fred J. Tobias is now with the U. S. Department of the Navy, Research and Development Dept., Reading, Pa., as Inspector of Navy Material.

Everett R. Turner, formerly with Dominion Tar & Chemical Co., is now Metallurgical Supervisor, Research and Development Dept., Canadian National Railways, Montreal.

Rudolph C. Valore, Jr., until recently with the National Bureau of Standards, Washington, D. C., is now Technical Consultant and Manager, Research and Development Division, Texas Industries, Inc., Dallas, Tex.

Mark W. Westgate, for many years with the National Paint, Varnish, and Lacquer Assn., as Chemist and Director of the Scientific Section, and Chief Chemist of the Technical Division, recently joined the staff of Gardner Laboratory, Inc., Bethesda, Md., as Technical Director. Dr. Westgate has been active in ASTM Committee D-1 on Paint, Varnish, Lacquer, and Related Products, as well as Committees D-22 on Methods of Atmospheric Sampling and Analysis, and E-5 on Fire Tests of Materials and Construction.

Robert L. Wolff was elected Vice-President of Engineering, Centralab Division, Globe Union, Inc., Milwaukee, Wis.

Ursula E. Wolff, formerly with Link-Belt Corp., Indianapolis, Ind., is now Metallographer, Lamp Wire and Phosphors Dept., General Electric Co., Cleveland (Ohio) Wire Plant.

Bert L. Wood recently retired as Consulting Engineer, American Iron and Steel Inst., New York City. He has served the steel industry for more than 40 years. He will continue in an advisory capacity as a part-time consultant. **William G. Kirkland,** who joined the AISI staff in 1947, will succeed Mr. Wood.

T. VanDyke Woodford, formerly with Walter N. Handy Co., Evanston, Ill., is now General Manager, Poz-L-ash Corp., Birmingham, Ala.

Frank L. Wright, until recently Manager of Research, Norma-Hoffman Bearings Corp., Stamford, Conn., is now engaged as a consultant in Glenbrook, Conn.

William A. Zinzow, who recently retired as Assistant Director of Development, Bakelite Co., Division of Union Carbide and Carbon Corp., Bound Brook, N. J., was honored by his associates with a farewell dinner the evening of November 21. A longtime member of the Society, a committee member and officer, and a former national director, Mr. Zinzow has been a staunch supporter of ASTM standardization and research work, and has aided greatly along administrative lines. He is currently serving on the Administrative Committee on Standards. Mr. Zinzow received an ASTM Award of merit at the 1955 Annual Meeting in recognition of sustained support of ASTM work, particularly in Committees D-9 on Electrical Insulating Materials, and D-11 on Plastics, where his outstanding technical knowledge and human understanding have been so effective.

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The following 67 members were elected from September 19 to November 15, 1955, making the total membership 8095. . . . . Welcome to ASTM

Note—Names are arranged alphabetically—company members first, then individuals. Your ASTM Yearbook shows the areas covered by the respective Districts.

CHICAGO DISTRICT

Rauland Corp., The, N. D. Levin, Chief Chemist, 4245 N. Knox Ave., Chicago 41, Ill.

Finley, Lyle W., Professor of Physics, Monmouth College, Monmouth, Ill. For mail: 1103 E. Detroit Ave., Monmouth, Ill.

Kane, Robert Leroy, Architect, Smith, Hinchman & Grylls, Inc., 800 Marquette Bldg., 243 W. Congress St., Detroit 26, Mich. For mail: 2575 Waukegan Ave., Highland Park, Ill.

McFatridge, W. P., Foreman, Metallurgical Control, Haynes Stellite Co., Kokomo, Ind.

Perry, Donald Michael, Jr., Chief Chemical Engineer, Pioneer-Central Div., Bendix Aviation Corp., Davenport, Iowa.

Sullivan, Virgil R., Technologist, Container Research, Quartermaster Food and Container Inst., 1819 Pershing Rd., Chicago 9, Ill. For mail: 1232 W. North Shore Ave., Chicago 36, Ill.

CLEVELAND DISTRICT

Fabing, Willard E., Technical Superintendent, Harn's Products Co., Milan, Ohio.

Kamm, O. Jacob, President, The Cleveland Quarries Co., Amherst, Ohio.

DETROIT DISTRICT

Fifty Corp., M. W. Munger, Chief Inspector, Bryan, Ohio.

Institute of Industrial Health, Warren A. Cook, Head, Industrial Hygiene, School of Public Health, University of Michigan, Ann Arbor, Mich.

Kircher, Charles E., Manager of Research, Detrex Corp., Box 501, Detroit 32, Mich.

Lamb, Byron A., Chemist, Presque Isle Corp., Box 321, Alpena, Mich. [J]*

Wirshing, Ralph J., Head, Chemistry Dept., General Motors Corp., Research Staff, Box 188, North End Station, Detroit 2, Mich.

NEW ENGLAND DISTRICT

Strum, Harold W., Construction Materials Engineer, Stewart Associates, Inc., 698 Massachusetts Ave., Cambridge, Mass. For mail: 46 Concord Lane, Cambridge 38, Mass.

NEW YORK DISTRICT

River Plate Corp., The, William W. Lewers, Consultant, 573–589 Ferry St., Newark 5, N. J.

Rome Iron Mills, Inc., W. E. Oliver, President, Canal St., Rome, N. Y.

U. S. Radium Corp., Samuel B. Wyatt, Research Chemist, S. Jefferson Rd., Whippany, N. J.

Feagin, Roy C., Chief Chemist, Austenal Laboratories, Inc., 224 E. Thirty-ninth St., New York 16, N. Y.

Goldfrank, Max, Technical Div., Stein, Hall and Co., Inc., 285 Madison Ave., New York, N. Y.

White, John J., Chief Specification Engineer, Parsons, Brinckerhoff, Hall & Macdonald, 51 Broadway, New York 6, N. Y.

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U. S. Naval Net Dept., Research and Development Department, G. E. Kampschaefer, Research and Development Officer, Tiburon, Calif.

OHIO VALLEY DISTRICT

Brandon, C. E., Assistant Technical Director, Howard Paper Mills, Inc., 115 Columbia St., Dayton 7, Ohio.

PHILADELPHIA DISTRICT

Ahlman, Charles W., Laboratory Engineer, Westinghouse Electric Corp., Lester, Pa. For mail: 309 Magnolia Lane, Delanco, N. J.

Allen, John William, Research Engineer, Aircraft-Marine Products, Inc., 25 Alexander Ave., Carlisle, Pa.

Davidson, Dale R., Head, Components Standards, Eckert-Mauchly Division, Sperry Rand Corp., 2300 W. Allegheny Ave., Philadelphia 29, Pa.

Haeger, Leonard G., Technical Director, Levitt and Sons, Inc., Levittown, Pa.

Milos, John, Vice-President, Operations, Phoenix Iron and Steel Co., 221 Bridge St., Phoenixville, Pa.

Ringwald, Owen E., Pigments Dept., Research Div., E. I. du Pont de Nemours and Co., Inc., Newport Plant, Newport, Del.

Roberts, Clyde A., Jr., Chief Engineer, Phoenix Iron and Steel Co., 221 Bridge St., Phoenixville, Pa.

Thielen, Albert F., Jr., Plastics Engineer, Philco Corp., C and Tioga Sts., Philadelphia 34, Pa.

Thomas, Harold C., Chief Supervisor, Design Div., E. I. du Pont de Nemours and Co., Inc., du Pont Chambers Works, Penns Grove, N. J.

PITTSBURGH DISTRICT

Keim, Laurence A., Technical Representative, Product Development Dept., Pittsburgh Plate Glass Co., 1 Gateway Center, Pittsburgh 22, Pa.

Kelly, James R., Manager of Technical Service Lab., Pennsylvania Industrial Chemical Corp., 120 State St., Clairton, Pa.

ST. LOUIS DISTRICT

Brock, Chelsey Lee, Jr., Metallurgical Engineer, Westinghouse Electric Corp., AGT Div., Box 288, Kansas City, Mo.

Russell, C. H., Division Chief Control Chemist, Monsanto Chemical Co., 710 N. Twelfth Blvd., St. Louis 1, Mo.

SOUTHERN CALIFORNIA DISTRICT

Edwards, R. F., Quality Control Director, International Rectifier Corp., 1521 E. Grand, El Segundo, Calif.

Sarna, Edward C., Laboratory Director, Furane Plastics, Inc., 4516 Brazil St., Los Angeles 39, Calif. For mail: 8007 Zelzah Ave., Reseda, Calif.

SOUTHWEST DISTRICT

Ingram Oil and Refining Co., J. A. O'Neill, Jr., Assistant Superintendent, Box RR, Chalmette, La.

Meyer, Raymond W., Technical Director, L.O.F. Glass Fibers Co., Box 20026, Houston 25, Tex. For mail: 5930 Indigo, Bellaire, Tex.

Soper, Douglas E., General Manager, El Paso County Water Control and Improvement District No. 1, Box G, Usleta, Tex.

WASHINGTON (D. C.) DISTRICT

U. S. Naval Ordnance Laboratory, Librarian, White Oak, Silver Spring, Md.

Westgate, Mark W., Technical Director, Gardner Laboratory, Inc., 4723 Elm St., Bethesda 14, Md.

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Steinhardt, Irwin J., Plant Chemist, General Electric Co., 1495 Fillmore Ave., Buffalo, 11, N. Y. For mail: 7139 Parkside Ave., Buffalo 14, N. Y.

U. S. AND POSSESSIONS

Arizona Sand and Rock Co., J. R. Blackwell, Materials Engineer, Box 959, Phoenix, Ariz.

Gramet, Inc., P. W. Bakarian, Vice-President and General Manager 3800 N. Hawthorne St., Chattanooga 6, Tenn.

Cromwell, C. A., Superintendent of Refining, Farmers Union Central Exchange, Inc., Box G, St. Paul, Minn. For mail: Box 126, Laurel, Mont.

Haskell, Albert A., Jr., Assistant to Technical Director, Titanium Metals Corporation of America, Box 2128, Henderson, Nev.

Johnson, James W., In Charge, Timber Mechanics, Oregon Forest Products Laboratory, Industrial Bldg., Seventeenth and May St., Corvallis, Ore.

Johnston, L. R., Owner, L. R. Johnston Drilling Inspection Co., 2650 Gov St., Mobile, Ala.

Mosby, J. V., Owner, Mosby Engineering Associates, Box 1779, Sarasota, Fla.

Waldron, Claude F., Chief Engineer, American Bosch Arma Mississippi Corp., Box 1111, Columbus, Miss.

OTHER THAN U. S. POSSESSIONS

Caribbean Refining Co., W. E. Robbins, Chief Chemist, Box 1786, Bayamon, Puerto Rico.

Egyptian Iron and Steel Co., A. M. Rizk, Managing Director, 54–56 Abdel Khalek Sarwat St., Cairo, Egypt.

Ellett Copper and Brass Co., Ltd., J. H. Hurley, Engineer, 92 W. Second Ave., Vancouver 10, B. C., Canada.

Far East Superintendence Co., Ltd., A. N. Petersen, Japan Manager, Central Box 240, Bergamo, Italy.

Ambrosioni, Antonio, Doctor of Chemistry, Soc. Montecatini, L.A.R. Via Sempione nº 5, Castelianza (Varese), Italy. For mail: Soc. Montecatini, via Turati, nº 18, Milan, Italy.

Beauchemin, Jacques, Representative, Ciment Fondu Lafarge (Canada) Ltd., 1405 Peel St., Suite 407, Montreal, P. Q., Canada.

Ben-Ozer, Israel, Production and Sales Manager, Cables of Zion Ltd., Rishon-le-Zion, Palestine.

Brown, G. F., Chief Mechanical Engineer, Victorian Railways, Spencer St., Melbourne, Australia.

Gutiérrez-Villeges, Josué, Soils Engineer, Empresa de Energía Eléctrica, Medellín, Colombia. For mail: Ap Nal 2321, Medillín, Colombia.

Kelman, Brian N., Manager, Ready Mixed Concrete Pty., Ltd., Box 1, Rivervale, Western Australia.

Nathorst, Helmer, Vice-President, Aktiebolaget Kanthal, Hallstahammar, Sweden.

Puebla, Manuel, Jr., Head of Mineral and Analytical Chemistry Section, Instituto Mexicano de Investigaciones Tecnologicas, Calzada Legaria 694, Mexico D. F. 10, Mexico.

Schinn, Rudolf, Engineer, Siemens-Schuckertwerke AG, Engelbertusstr 110, Mülheim-Ruhr, Germany.

Tekel Enstitüleri (Institutes of Monopolies), Cevizli-Maltepe-Istanbul, Turkey.

Tomecko, Joseph W., Assistant General Manager, Paints and "Fabrikoid" Div., Canadian Industries (1954) Ltd., Box 10, Montreal, P. Q., Canada.

Universidad de Villanueva, Bureau de Patrones de Calidad, Box 6, Marianao, Havana, Cuba.

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* [J] denotes Junior Member.

DEATHS . . .

Aaron B. Bagsar, Consulting Metallurgical Engineer, and retired Chief Metallurgical Engineer, Sun Oil Co., died October 7, 1955, at his home, 2426 Garrett Road, Drexel Hill, Pa. He was 58. Member since 1923. Born in East Turkey, Dr. Bagsar was 17 years of age when his family was wiped out in World War I. He came to this country in 1921, and three years later was graduated from the University of California, subsequently receiving his Master's degree from the University of Idaho, and Ph.D. from Columbia. An outstanding authority in the application of metals to refinery operations, Dr. Bagsar had been with the Marcus Hook Refinery of Sun Oil Co. from 1932 until his retirement last year. During World War II he was a member of a subcommittee of the War Production Board and the Armored Plate Welding Research Committee of the National Academy of Sciences. Through the years he had made outstanding contributions to the work of ASTM, serving on Committees A-1 on Steel, A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, B-2 on Non-Ferrous Metals and Alloys, B-5 on Copper and Copper Alloys, and C-16 on Thermal Insulating Materials. He also served on the Joint (ASTM-ASME) Committee on Effect of Temperature on the Properties of Metals. For several years he was a member of the ASTM Philadelphia District Council.

Dean Harvey, Consulting Materials Engineer, retired Electrical and Materials Engineer, Westinghouse Electric Corp., Pittsburgh, Pa.; and ASTM Past-President and Honorary Member (October 12, 1955). (See article on page 90.)

Raymond Deutsch, President, Monarch Aluminum Manufacturing Co., Cleveland, Ohio. Representative of company membership since 1943.

Grant J. Durant, President, Froehling & Robertson, Inc. (Testing and Inspection Labs.), Richmond, Va. (October 22, 1955). Representative of the company membership since 1936, he was a consistent, loyal, constructive worker for many years in Committees C-1 on Cement, C-9 on Concrete and Concrete Aggregates, and C-15 on Manufactured Masonry Units, rendering valued aid in bringing before these cementitious groups the important "viewpoint of the consumer." He served on numerous subcommittees, heading for a time the group concerned with heat of hydration. He also was interested in the ASTM Washington District activities and sparkplugged for the Society a very fine meeting held in Richmond a few years ago. He will be greatly missed by his committee associates and other friends in the Society.

Clyde F. Hayward, Research and Development Division, Lever Brothers Co., Edgewater, N. J. (September 10, 1955).

(*Continued on page 86*)

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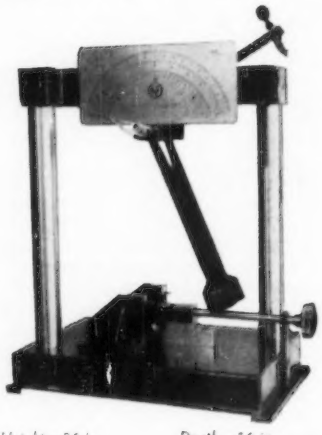

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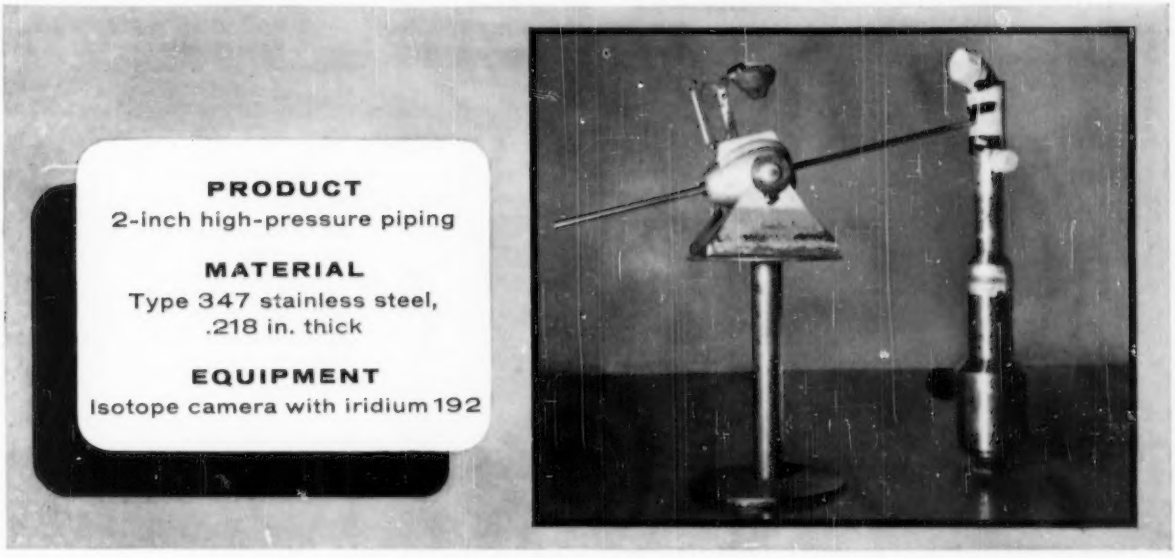

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Every joint in it is welded—then radiographed to insure soundness.

For these exposures the radiographer uses iridium 192 having a source strength of 3200 milliroentgens at one meter. Exposure time is 90 secs. at a distance of 2¼ inches. The film is Kodak Industrial X-ray Film, Type A.

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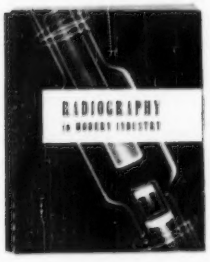

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(*Continued from page 83*)

Representative of his company on Committee D-12 on Soaps and Other Detergents since 1950, serving on several subgroups; also member of Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys since 1951.

Horace Hardy Lester, ASTM Honorary Member, Principal Physicist, Watertown Arsenal, Department of the Army, Watertown, Mass. (November 11, 1955). (See accompanying article.)

Fred S. Mapes, Mechanical Section Engineer, General Electric Co., Schenectady, N. Y. (August, 1955). Personally affiliated since 1951; and for the past 27 years as representative of his company, a very active participant in much of the technical work of the Society. He served on the following committees for varying periods, heading a number of the subgroups: Committees A-1 on Steel, A-3 on Cast Iron, A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys, B-5 on Copper and Copper Alloys, B-6 on Die-Cast Metals and Alloys, B-7 on Light Metals and Alloys, D-9 on Electrical Insulating Materials, D-13 on Textile Materials, E-1 on Methods of Testing, and E-9 on Fatigue. He represented ASTM for many years on the Inter-Society Color Council, also represented the Society on ASA Sectional Committee C 59 on Electrical Insulating Materials.

Arthur D. Morris, President, Bayonne Bolt Corp., New York City. (October 27, 1955.) Personal member of the Society since 1950 and active in Committees A-1 on Steel and A-2 on Wrought Iron. Also previously active for many years in these groups, as representative of the American Institute of Bolt, Nut, and Rivet Mfrs., and of the Industrial Fasteners, heading for some time the Subcommittee on Bolting.

J. C. Morris, Chief Librarian, Oak Ridge National Laboratory, Oak Ridge, Tenn. (September 23, 1954.) Representative of Laboratory membership since 1951.

E. C. Petrie, North American Refractories Co., Cleveland, Ohio. (November 2, 1955.) Consulting member since 1953 of Committee C-8 on Refractories, and Subcommittees II on Research, and III-G Tests—Section on Porosity and Permanent Volume Change.

Harry S. Read, Harry S. Read Co., Westfield, N. J. (August 9, 1955.) Member since 1940, serving on Committee E-2 on Emission Spectroscopy, and its Subcommittee IV on Standards and Pure Materials.

Blaine S. Smith, retired President of Universal Atlas Cement Co., New York City, and prominent figure in the cement and allied industries, died suddenly October 27, 1955, at New Rochelle, N. Y., Hospital. A Past-President and Honorary Member of the Portland Cement Assn., Mr. Smith was affiliated with, and active in many other groups. He represented the Sustaining Membership of the Universal Atlas Cement Co. in ASTM for many years.

Don W. Smith, Architect, Sweetwater, Tex. (September 7, 1955.) Member since 1948.

DEAN HARVEY

1879–1955

Dean Harvey, Consulting Materials Engineer; retired Electrical and Materials Engineer, Westinghouse Electric Corp., Pittsburgh; and ASTM Past-President and Honorary Member, died October 12, 1955, at the age of 76. A native of Chicago and a graduate of the Armour Institute of Technology, Mr. Harvey was associated with the Underwriters Laboratories as Electrical Engineer 1900–1904, and for 42 years, until his retirement in 1946, was with Westinghouse Electric Corp. During World War II he devoted several days weekly to War Production Board work in Washington as a consultant in the Conservation Division concerned chiefly with electrical and mechanical work. Following his retirement from Westinghouse he engaged in private practice as a materials consultant.

Joining the Society in 1913, Mr. Harvey was extremely active through the years in both technical and administrative phases of ASTM work. His continuous and intensive activity over three decades in Committees B-4, D-9, and D-13 was most outstanding. He was chairman of B-4 on Metallic Materials for Electrical Heating, Electrical Resistance, and Electrical Contacts 1926–1946, serving also on many subgroups, and was elected honorary chairman and an honorary member of B-4 in 1946. Since 1921 he had been a member of D-9 on Electrical Insulating Materials, acting successively as representative of Westinghouse and the National Electrical Manufacturers Assn. and on his personal membership—serving as vice-chairman 1926–1944, and being elected to honorary membership in this group in 1952. He had been affiliated with Committee D-13 on Textile Materials since 1923, serving on upward of 20 subgroups, and being elected to honorary membership in this committee in 1946.

He also served relatively long periods on Committees A-1 on Steel, E-8 on Nomenclature and Definitions, and the ASA Sectional Committee C 59 on Electrical Insulating Materials.

Mr. Harvey was a member of the Society's Committee on Papers and Publications for several years; member of the Board of Directors 1938–1940; Vice-President of the Society 1941–1943, and President 1943–1944.

Over a long period he had taken great interest in District activities, being a member of the organizing group of the Pittsburgh District Council, serving as District chairman 1934–1938, and elected to honorary membership in the Council in 1951.

Many of his technical contributions were published in the ASTM *Proceedings*, also in the *Electric Journal*. In 1943 he received the Westinghouse Award of Merit for distinguished service in developing materials and process specifications, for notable work in connection with insulating oils, and for contributions to the war effort in the WPB Conservation Division. In 1950 he was elected to Honorary Membership in ASTM, in recognition of his valued contributions to the work of the Society, and for eminence in the field of materials.

In the passing of Mr. Harvey, ASTM loses a very loyal and zealous member, one whose outstanding contributions aided greatly in furthering the work of the Society. A regular attendant at national and District gatherings, as well as technical meetings, he will be greatly missed by all his friends and associates.

HORACE HARDY LESTER

1883–1955

Horace Hardy Lester, ASTM Honorary Member, Principal Physicist since 1922 at Watertown Arsenal, Department of the Army, Watertown, Mass., died November 11, 1955, in his 72nd year. Born in Shelburn, Ind., Dr. Lester received his A.B. in 1906 from the University of Minnesota, his A.M. from the University of Washington (Seattle) in 1912, and Ph.D. from Princeton in 1915. He was Instructor in Physics at Princeton, 1914–1915, and at Washington (Seattle), 1915–1917; Radio Laboratorian, Puget Sound Navy Yard, 1917–1920; Physicist, Westinghouse Lamp Co., 1920–1921; and Assistant Professor at Case Institute of Technology, 1921–1922.

Eminent in the radiographic field, his research activities embracing many phases of radiographic work, he contributed especially to developments in index of refraction of water, thermionics, radiography of metals, defects in cast steel, elastic properties of iron crystals in steel, distribution of carbon in steel, and X-ray metallography.

Affiliated with ASTM since 1924, Dr. Lester rendered outstanding service to the Society. His pioneering efforts in the field of industrial radiography; his leadership in the formation of ASTM Committee E-7 on Nondestructive Testing and as chairman of that group from 1938 to 1948, and his continuing contributions in this committee; his stimulation of research work in various fields of nondestructive testing; his encouragement of other workers, and his interest in the committee sponsorship of technical papers and symposiums—all resulted in valued assistance by the Society to industry and Government.

While his efforts in the Society were

(*Continued on page 87*)

(Continued from page 86)

concentrated chiefly in Committee E-7. Dr. Lester made important contributions in other committees, including A-1 on Steel, E-4 on Metallography, and the Joint Committee (American Crystallographic Association, British Institute of Physics, and ASTM) on Chemical Analysis by Powder Diffraction Methods. For some years he represented the Society on ASA Sectional Committee Z54 on Safety Code for the Industrial Use of X-Rays.

A member of the New England District Council of the Society since its organization in 1946, Dr. Lester served as Council chairman 1950–1954.

In 1951 he received an ASTM Award of Merit in appreciation of his valued contributions; and in 1953 he was accorded the Society's highest honor, Honorary Membership, recognizing eminence in his field and the great stimulus he had given to the work of ASTM in the area of nondestructive testing.

He was an affiliate of many other technical and scientific groups including the American Physical Society, American Society for Metals, and the Society for Nondestructive Testing. The latter has an award named for him, of which he was the 1950 recipient.

The Society loses a distinguished member. The impact of his thinking and association continues as a tribute to his ceaseless efforts in the field of radiographic research and scientific testing. Assiduous in his work, youthful in spirit, and always ready with counsel and encouragement, Dr. Lester was respected, admired, and loved by his friends, associates and co-workers. His loss will be keenly felt by all with whom he had been associated in ASTM.

Statistics Short Course

THE Institute of Statistics at North Carolina State College is sponsoring a seven-day intensive short course in Statistical Methods for Research Workers in Industry and the Physical Sciences starting February 12, 1956, and running daily through February 18, 1956. This program is designed to acquaint research workers in industry and the physical sciences with modern techniques of statistical analysis and experimental design. Three lecture series will be given: one on Elementary Statistical Analysis; one on Regression Analysis; and the third on Experimental Design. Guest lectures will include W. G. Cochran, The Johns Hopkins University, S. L. Crump, University of Rochester, and J. S. Hunter, American Cyanamid Co.

A registration fee of $100 will be charged and enrollment will be limited to the first fifty applicants. For further information write to Institute of Statistics, North Carolina State College, Box 5457, Raleigh, N. C.

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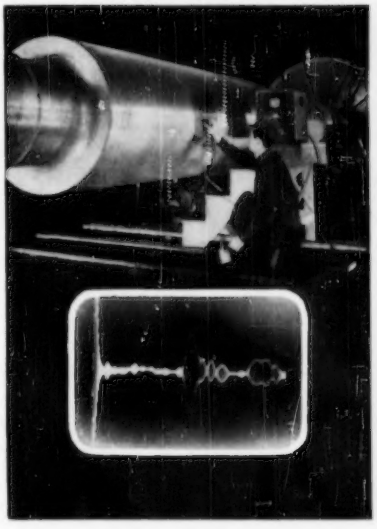

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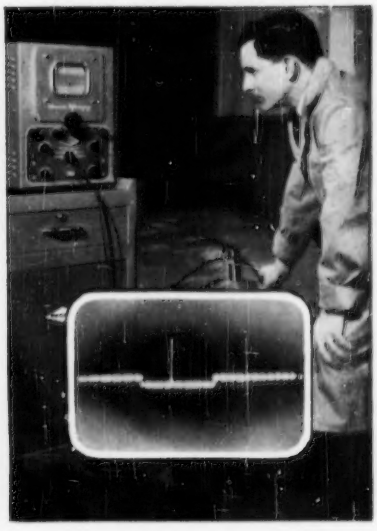

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Cut wasted machine and man hours by locating and evaluating both surface and internal defects in your stock materials before expensive machining.

Eliminate costly production delays by discovering fatigue cracks in your heavy equipment before they lead to breakdown.

Speed and improve inspection of your critical finished parts.

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Measure thickness of steel sheet where only one surface is available.

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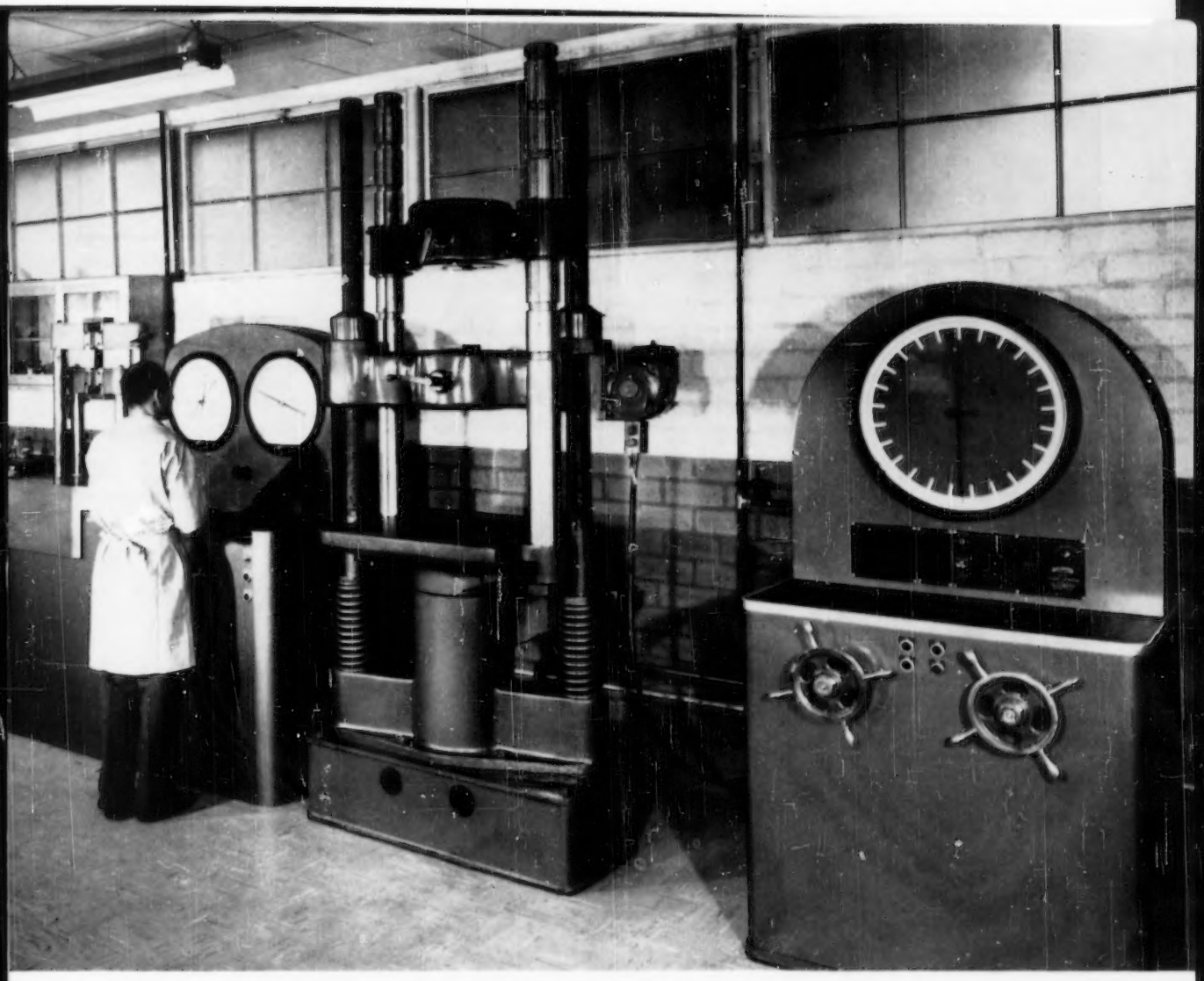

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Sciaky finds their Baldwins give them invaluable testing service in this intensive research program. The accurate, dependable performance of these machines is enabling Sciaky to meet and exceed new requirements and problems prompted by the daily growth in the use of resistance welding.

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Note—This information is based on literature and statements from apparatus manufacturers and laboratory supply houses

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American Instrument Co., Inc., Silver Spring, Md.

Paper Burst Tester—Makes paper burst testing a simple, foolproof operation.
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The Atomic Center, Inc., 489 Fifth Ave., New York, N. Y.

Air Dryer—Can be used with infrared spectrophotometers; in low-temperature studies to prevent moisture fogging glassware, windows or mirrors; in balance enclosures or wherever reactions must be carried on under moisture-free conditions.
Beckman Div., Beckman Instruments, Inc., Fullerton, Calif.

Liquid Leveler—Applicable to all open type liquid containers, electronic liquid leveler automatically maintains liquid level of bath mediums within a level constancy of ±0.046 in.
Blue M Electric Co., 138th & Chatham St., Blue Island, Ill.

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Buehler Ltd., 2120 Greenwood St., Evanston, Ill.

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Chemical Development Corp., Endicott St., Danvers, Mass.

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Chesapeake Instrument Corp., Shadyside, Md.

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Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, Long Island, N. Y.

Potentiometer—Offering a high degree of accuracy in a resistance range of 80 to 150,000 ohms.
Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, Long Island, N. Y.

Turntable Indicating Amplifier—Ideal for use as a null detector for AF and RF test bridges and other applications and for measurement of iron core coils.
Federal Telephone and Radio Co., 100 Kingsland Road, Clifton, N. J.

L-C Precision Bridge—An instrument providing precision measurement of inductance and capacitance.
Instrument Div., Federal Telephone and Radio Co., 100 Kingsland Road, Clifton, N. J.

Purge Meter—Featuring all-metal, rugged construction—1500 psi ASA pressure rating—combined with low cost, this new meter gives safe, inexpensive metering of any purge fluid.
Fischer & Porter Co., Hatboro 35, Pa.

Force-Balance Instrument—A pneumatic force-balance flow transmitter for accurate, instantaneous transmission of differential pressure.
Fischer & Porter Co., Hatboro 35, Pa.

Spectranal—Two new models of a simple spectrum-analyzing instrument for the rapid identification of 61 metallic and nonmetallic elements.
Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Ultra-Pure Reagents—A line of ultrapure chemicals has been developed specifically to help remove the last area of guesswork in spectrophotometry.
Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Differential Voltmeter—Extremely useful when checking response and attenuation of filters, transformers, amplifiers, and other applications where a small difference in two voltages is to be measured.
Freed Transformer Co., Inc., 1715 Weirfield St., Brooklyn 27, N. Y.

Speed-Controls—Complete 1 and $1\frac{1}{2}$-hp motor speed controls are available at a reduction in cost of about 25 per cent over earlier models.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Lanameter—A projection microscope designed specifically for the measurement and analysis of wool fibers.
William J. Hacker & Co., Inc., 82 Beaver St., New York 5, N. Y.

Balancing Machine—High precision electronic balancing machine is announced which enables smaller cylindrical bodies (such as rotors, armatures, fan units, etc.) to be dynamically balanced.
The Hickok Electrical Instrument Co., 10618 Dupont Ave., Cleveland 8, Ohio.

Beam Deflection Indicator—For measuring pavement deflections directly under slowly moving vehicles.
Hogentogler and Co., 5218 River Road, Washington 16, D. C.

Test Chamber—Simulation of pressure conditions corresponding to altitudes as high as 350,000 ft can now be obtained with the Hudson Bay Model 5500 Iono-Chamber.
Hudson Bay Co., Div. of Labline, Inc., 3070 W. Grand Ave., Chicago 22, Ill.

Low-Cost Ohmmeter—Retains all the operating features and ranges of its higher priced counterpart, but is housed in the

(*Continued on page 92*)

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Elongation, yield point, modulus, relaxation, hysteresis — stress-strain properties like these, are being measured with new ease and significance by the INSTRON in leading laboratories the world over.

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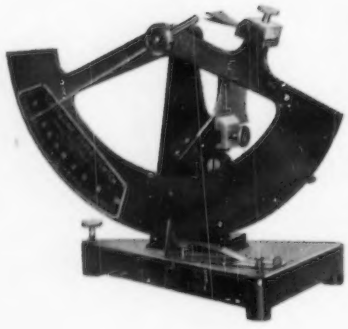
ELMENDORF TEARING TESTER



The Elmendorf Tearing Test has long been an ASTM standard Measuring the internal tearing resistance of textiles, paper and sheet materials, the Elmendorf test is the practical one for evaluating wearing quality. **It is a measure of service.**

Elmendorfs anywhere will perform alike under like conditions since they utilize gravity for their operation; **the readings must be correct.** The standard instrument has a capacity of 1600 grams and there are models to test materials from 25 grams to 25,600 grams.

THWING-ALBERT INSTRUMENT COMPANY

5339 Pulaski Avenue **Philadelphia 44, U.S.A.**

123

(*Continued from page 90*)

usual rubbed hardwood case, eliminating the costly gasketed metal case of the Model LRO.

Industrial Instruments, Inc., 89 Commerce Road, Cedar Grove, N. J.

Electrolytic Conductivity Instruments—Highly sensitive, easy-to-use electrolytic conductivity instrument especially designed for detecting slat water intrusions or presence of slugs of pollution in streams and wells.

Industrial Instruments, Inc., Cedar Grove, N. J.

Fatigue Testing Machine—A new fatigue testing machine with total force capacity of 12,000 lb, the first constant force machine designed for multirange fatigue testing.

The Ivy Co., Norwalk, Conn.

Microvoltmeter-Ammeter—Capable of making accurate measurements of voltages as small as 10 μv and currents as small as one micro-μa.

Kay Lab., Box 16, San Diego 12, Calif.

Nondestructive Inspection—Electronic testing equipment designed for the metal-producing and metal-working industries to inspect nonmagnetic stainless steel bars and tubing.

Magnetic Analysis Corp., 42-44 12th St., Long Island City, N. Y.

Photoelectric Analyzer—New instrument for automatically analyzing, recording and controlling chemical processes involving liquids, vapors, or gases.

Manufacturers Engineering and Equipment Corp., Hatboro, Pa.

Scotchply—First formable reinforced plastic sheeting ready for use in mass production—a moldable, high-strength, uniform quality glass-reinforced plastic sheeting engineered for structural jobs.

Minnesota Mining and Manufacturing Co., 900 Fauquier Ave., St. Paul 6, Minn.

Gas Flowmeter—Linearly indicates directly in volumetric flow units.

National Instrument Labs., Inc., 6108 Rhode Island Ave., Riverdale, Md.

Gas Flow Element—All-metal unit of rigid construction so arranged as to provide a multiplicity of flow channels in which the Reynolds number is kept below 4000 at full scale flow.

National Instrument Laboratories, Inc., 6108 Rhode Island Ave., Riverdale, Md.

Electrical Thermometer—A precision electrical thermometer suitable for directly indicating gage block or other metal surface temperatures to an accuracy of 0.01 F over the range 67 to 69 F.

National Instrument Laboratories, Inc., 6108 Rhode Island Ave., Riverdale, Md.

Radioactive Potassium Thisiyanate—Labeled with radioactive carbon-14, this material is expected to find use in the study of plastics, metallic complexes and in radio-chemical analysis.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

Rotational Viscometer—High-speed, wide-range instrument for determining the viscosity, yield value and thixotropic break-down of highly viscous materials.

Precision Scientific Co., 3737 W. Cortland St., Chicago 39, Ill.

Test Cell—Originally designed for determining evaporation losses of low viscosity lubricating oils used in subzero temperatures, the evaporation test cell, can now be used for testing both greases and oils, regardless of their viscosity

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

High-Temperature Bath—Constant-temperature bath capable of continuous high-temperature operation in tempering, conditioning, preheating and stability tests, and in routine laboratory work. Especially suited for the needs of the rubber and plastics industries, the bath conforms with ASTM Methods D 471 and D 735.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Explosion-Proof Fixture Hangers—New threaded cover fixture hanger "Pylets" for suspending explosion-proof or dust-tight pendent lighting fixtures.

Pyle-National Co., 1334 N. Kostner, Chicago, Ill.

Explosion-Proof Instrument Enclosure—For convenient reading of enclosed meters, gages, or similar devices in hazardous locations.

Pyle-National Co., 1334 N. Kostner, Chicago, Ill.

Force-Flow Liquid Chiller—For refrigerating and circulating various liquids and bath temperature control.

Remcor Products Co., 321 E. Grand Ave., Chicago 11, Ill.

(*Continued on page 94*)

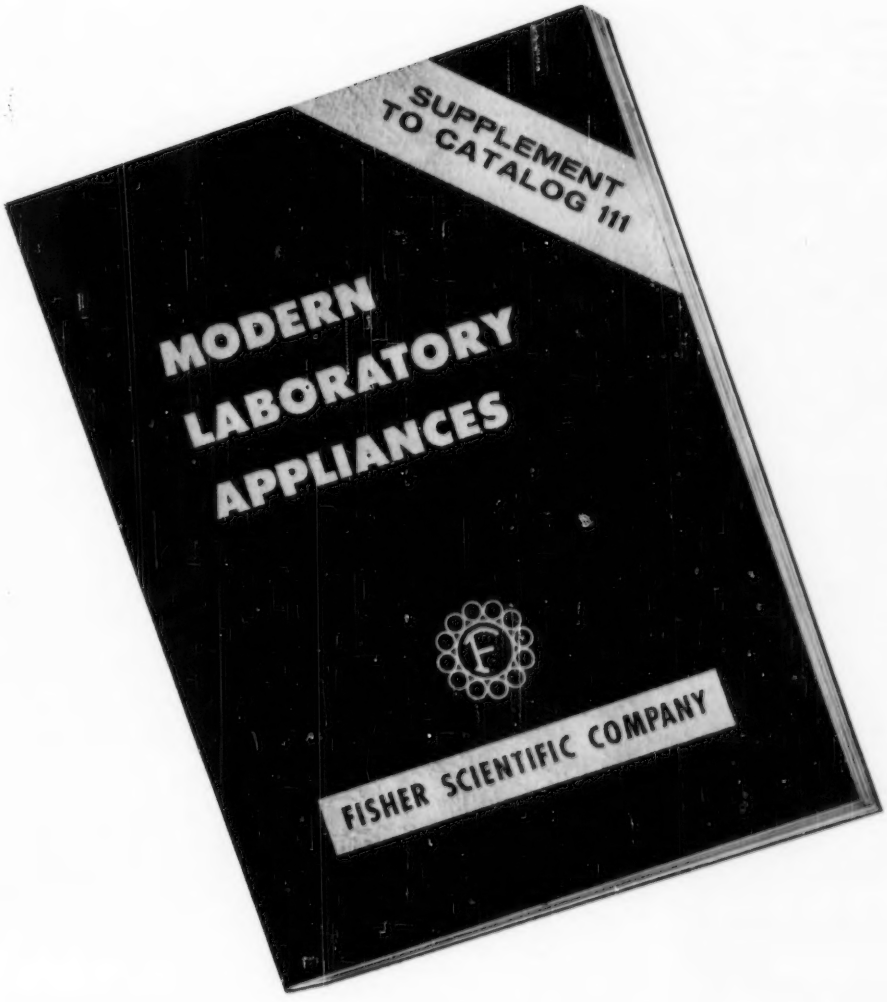
(*Continued from page 92*)

Low-Temperature Cooler—For use in scientific laboratory work as small deep freeze, a low temperature trap for evacua-

signed to measure the internal bond strength of kraft paper.

Testing Machines, Inc., 123 W. 64th St., New York 23, N. Y.

Digest No. 3, 16 pages, liberally illustrated, depicting a variety of laboratory apparatus and equipment including mobile air conditioners, liquid coolers, portable refrigeration systems, flexible heating



CONDENSED—*to serve you better*

TIME, to the chemist, is more precious than plutonium. That's why the Fisher Catalog Supplement has been edited so carefully. In fact, this indispensable little reference book takes only 112 pages to list *all* the instruments, apparatus, glassware and laboratory furniture added to Fisher stocks since the 1952 publication of the Fisher Catalog.

The Catalog itself was quite a feat: so compressed and clarified that its 986 pages contain an even *wider* selection than the 1500-page "giants" on catalog shelves.

All of the items in the new supplement, selected and tested by the Fisher technical staff, are factually described; painstaking woodcuts as well as action photos assist the text. In addition, the supplement presents dozens of major instruments newly developed and manufactured by Fisher and not available elsewhere. (For your convenience, the supplement is not burdened with reagents; 7000-plus Fisher reagents are listed separately in the handy Fisher Chemical Index.)

Used together, the catalog and supplement place in your hands the largest, most comprehensive assortment of laboratory tools available anywhere. If you have not received your copy, write for catalog supplement 111, 717 Forbes Street, Pittsburgh 19, Pennsylvania.

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(*Continued from page 92*)

Low-Temperature Cooler—For use in scientific laboratory work as small deep freeze, a low temperature trap for evacuations, or reservoir for circulating cold water for extraction columns.
Remcor Products Co., 321 E. Grand Ave., Chicago 11, Ill.

Level-Controller—Utilizes the accuracy of electronic capacitance sensing elements to detect minute changes in levels in tanks, drums, process baths, pipelines, and other conveyors.
Robertshaw-Fulton Controls Co., Fielden Instrument Div., 2920 N. 4th St., Philadelphia 33, Pa.

Torque-Motor—Square shaped, instant oscillating torque motor obtains 280 deg rotation without linkage or gearing.
Roto-Mation Motors, Inc., 525 S. Riverside, St. Clair, Mich.

Serial Marker—Device for photographing a four-digit number on a negative for reference purposes.
Spex Industries, Inc., 80-56 230th St., Queens Village 27, N. Y.

Thermometer Pigment—New pigment provides lasting legibility; adds longer life to the instrument; and eliminates possibility of contamination of solutions by dissolved pigments.
Taylor Instrument Cos., 95 Ames St., Rochester 1, N. Y.

Paper Strength—An instrument designed to measure the internal bond strength of kraft paper.
Testing Machines, Inc., 123 W. 64th St., New York 23, N. Y.

CATALOGS AND LITERATURE

SR-4 Fluid Pressure Cells—SR-4 fluid pressure cells and their uses in electrical measurement and control of pressure are presented in a new 16-page *Bulletin 4306* issued by Baldwin-Lima-Hamilton Corp.
Baldwin-Lima-Hamilton Corp., Philadelphia 42, Pa.

Infrared Detectors—Detectors used as sensing elements in radiometers, pyrometers, infrared spectrometers and other infared instruments are described in a new bulletin called *OptiTherm Infrared Detectors.*
Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.

Kromo-Tog—*Booklet 83* describes The Kromo Tog, a new self-contained instrument for the analysis of gases and liquids by gas chromatography.
Burrell Corp., 2223 Fifth Ave. Pittsburgh 19, Pa.

Process Refractometer—For monitoring and control of petroleum and chemical processes. *Bulletin 1839.*
Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 15, Calif.

Apparatus Digest—*Daigger Apparatus Digest No. 3*, 16 pages, liberally illustrated, depicting a variety of laboratory apparatus and equipment including mobile air conditioners, liquid coolers, portable refrigeration systems, flexible heating tapes, interval and signal timers, etc.
A. Daigger & Co., 159 W. Kinzie Ave., Chicago 10, Ill.

Precision Electrical Instruments—Four-page catalog devoted to description of new instruments and components.
Electro Measurements, Inc., 4312 S. E. Stark St., Portland 15, Ore.

Automatic Sampling—Application to many different problems is discussed in a new *Bulletin SUB4.*
Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.

Pilot Plant and Laboratory Equipment—Seventy-six page catalog, "*Denver Laboratory Equipment,*" describing over 146 different items to help you establish your own laboratory testing needs.
Denver Equipment Co., P. O. Box 5268, Denver 17, Colo.

Contour Projectors—A new catalog which describes the six models of Kodak Contour Projectors now available.
Special Products Sales Div., Eastman Kodak Co., 343 State St., Rochester, N. Y.

Laboratory Apparatus—A new 44-page illustrated *Catalog 55D* shows the complete line of laboratory equipment manufactured by Eberbach.
Eberbach Corp., Ann Arbor, Mich.

The Laboratory—Volume 24, number 5 features a look at the birthplace of the American Iron industry at Saugus, Mass., an ironworks recently restored as a monument to the scientific pioneers of 17th Century New England; also the research behind the modern hot dog (8½ billion frankfurters are sold in the United States alone each year).
Fischer Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.

Gage Application—Eight page brochure illustrates and describes a broad variety of standard and special gages, and measurement control methods.
Freeland Gauge Co., 9940 Freeland Ave., Detroit 27, Mich.

Manual Photometric Unit—For the measurement of color, gloss, reflectance and other optical properties (*Bulletin No. 162*).
Gardner Laboratory, Inc., Bethesda 14, Md.

Vibration Measurement—A new publication, "Measurement of Vibration," consisting of 64 pages, covers the meaning of vibration terms, description of vibration-measuring instruments, procedures, typical examples, and interpretation of results. A short section is devoted to the human response to mechanical vibration.
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Instrumentation and Control—Automatic control and instrumentation components; water conditioning and steam testing equipment, chemical feeding devices; chemicals for food processing, paper processing and for metal protection—these are some of the subjects discussed in a new 28-page *Bulletin GSP-901.*
Hagan Corp., 323 Fourth Ave., Pittsburgh 30, Pa.

(*Continued on page 96*)

Only 20 minutes to determine hydrogen content in most metals and alloys with the new, low-cost...

LEDOUX HYDROGEN DETERMINATOR

... so simple any of your technicians can operate it!

... results are more accurate!

LEDOUX'S NEW HYDROGEN-DETERMINATOR determines hydrogen in Ti, Zr, V, W, Ce, Ta, Nb, Co and Ni metals and alloys as well as in many other metallurgical materials. The combustion technique is followed and accurate determinations are possible in concentrations ranging from 0.003% to those occurring in the metal hydrides. Reduces determination time to 20 minutes; so simple any technician can operate it; results are more accurate;

NOW AVAILABLE!

can be used on widely differing metals and alloys; also effective in determining C and S; saves operating cost; priced lower than you think.

Ledoux's new HYDROGEN-DETERMINATOR was developed as a result of *Ledoux* & Co.'s continuous efforts to bring you newer and better methods and analytical instruments. For complete details—prices and literature—write to Dept. 11.

LEDOUX & COMPANY
Teaneck, New Jersey

(*Continued from page 94*)

Precision Mechanism Production—The

Inspection as a Production Tool—This booklet discusses various uses for testing; how a nondestructive testing program can

ASTM specifications for calibrating materials-testing machines.
Morehouse Machine Co., 233 W. Market

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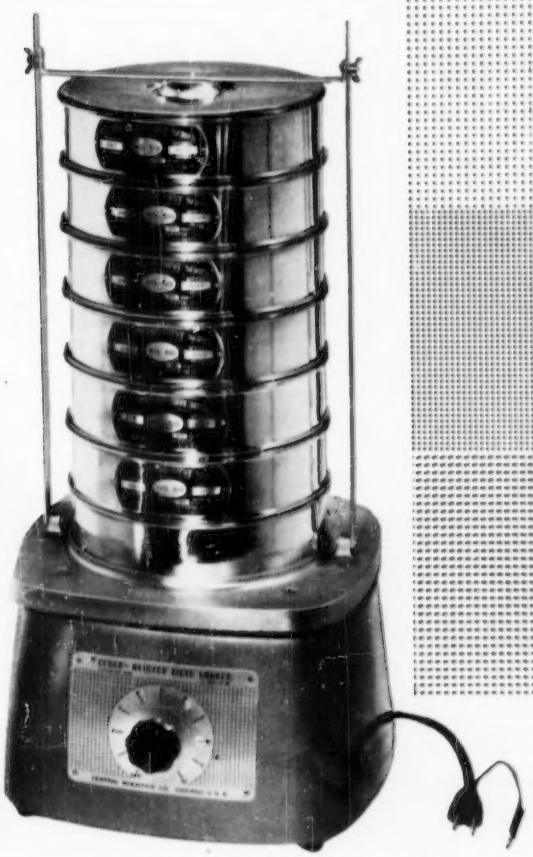

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* for mechanical analysis of industrial materials . . . for sieving heavy mineral powders, light organic samples, fine pharmaceutical powders.
* holds six standard 8-inch or 5-inch sieves.
* will separate a mixture, by particle size, into six components in one operation.
* provides quick, accurate separation without caking or plugging sieves.
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(Continued from page 94)

Precision Mechanism Production—The whole current technology of precision mechanism manufacture is pictorially reviewed in a 32-page publication entitled "Production Processing and Service Facilities."

Allied Products Div., Hamilton Watch Co., Lancaster, Pa.

Tube Fittings—New Nylo Seal Tube Fittings, molded from Du Pont "Zytel" (nylon), which can be used with either plastic or metal tubing. *Bulletin 3049.*

The Imperial Brass Mfg. Co., 1200 W. Harrison St., Chicago 7, Ill.

Rayotube Detectors—Full description of Rayotube (heat-radiation) Detectors, for continuous temperature measurement to 5000 F and beyond, is available in a 24-page illustrated *Catalog EN-83.*

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Voltage Divider—"Precision Voltage Divider" which provides a ratio as small as 1:100,000 and is correct within ±1 part of 0.001 per cent of the total (*Data Sheet E-51(4)*).

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Potentiometer—*Data Sheet E-51(3)* describes the circuitry and construction in detail and points out the widespread use of this potentiometer in industrial and research laboratories.

Leeds & Northup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

Inspection as a Production Tool—This booklet discusses various uses for testing; how a nondestructive testing program can be instituted in the production departments, as a cost-reducing, money-saving tool; and how inspection should be considered productive machinery.

Magnaflux Corp., 7300 W. Lawrence Ave., Chicago 31, Ill.

Temperature Controller—*Specification Sheet 866* describes the new Honeywell Ambi-Stat remote bulb temperature controllers.

Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

Resin Experimentation—*Data Sheet No. 2.10-3* describes 5- and 15 gal pilot plants for making recording temperature control instruments. Test batches of varnishes, plastics, cellulose, synthetic textiles and enamels.

Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

High Speed Radiamatic Unit—*Bulletin 9320* describes a new high-speed radiation detector which responds to 98 per cent of any temperature change in less than ½ sec.

Wayne and Windrim Aves., Philadelphia 44, Pa.

Proving Ring—*Bulletin No. 116* describes and diagrams the working principles of both compression-type and tension-type proving rings meeting all Federal and ASTM specifications for calibrating materials-testing machines.

Morehouse Machine Co., 233 W. Market St., York, Pa.

Vacuum Pumps—New 16-page color *Brochure No. 1102* illustrates and describes vacuum and liquid pumps, air brake equipment, and hydraulic motors, controls and pumps.

The New York Air Brake Co., 230 Park Ave., New York, N. Y.

Viscosity Bath—*Bulletin 743* describing the redesigned Model "S" Kinematic Viscosity Bath provides easier, more accurate viscosity determinations.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Film Badges—New 2-page specification sheet describing film badges worn at breast level or on the wrist to indicate the amount of radiation which laboratory and other workers are receiving from X-rays or radioactive isotopes.

Nuclear Instrument and Chemical Corp., 229 W. Erie St., Chicago 10, Ill.

Amplifier—Complete data on a new Operational Amplifier, Model K2-X, recently added to the Philbrick line of Electronic Analog Components is described in new technical *Bulletin K2-X.*

George A. Philbrick Researches, Inc., 230 Congress St., Boston 10, Mass.

Vacuum Oven—*Bulletin 377* discusses the greater drying speed, the close accuracy afforded by the hydraulic thermostat, the large working space of the square chamber, and other features of the oven.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Viscosity Bath—*Bulletin 743* describing the redesigned Model "S" Kinematic Viscosity Bath.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

"Midget" Water Still—*Bulletin 912* on "Midget" Water Still, a laboratory still especially designed for small-volume but high-purity requirements.

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Low-Temperature Cabinet—*Bulletin 339* discusses applications, the two temperature uniformity, the operating principle of the low temperature range, and construction of the "Dual Range."

Precision Scientific Co., 3737 W. Cortland St., Chicago 47, Ill.

Absolute Pressure Gage—Designed for industrial and marine equipment employing minus pressures (turbine condensers, exhaust hoods, evaporators, etc.), the Princo Absolute Pressure Gage is shipped ready to operate (*Bulletin D-1*).

Precision Thermometer and Instrument Co., Philadelphia, Pa.

Controlled Volume Pump—*Bulletin 955* describes latest addition to line of Controlled Volume Pumps for low capacity flow control.

Milton Roy Co., Station O, 1300 East Mermaid Lane, Phila. 18, Pa.

Laboratory Equipment—New edition of "What's New for the Laboratory," contains a six-page insert giving complete information on the new line of Ohaus Harvard Trip Balances.

Scientific Glass Apparatus Co., Inc., Bloomfield, N. J.

(Continued on page 98)

UNIVERSAL CALIBRATING MACHINE

Morehouse

CAPACITIES AVAILABLE

10,000 lbs.
30,000 lbs.
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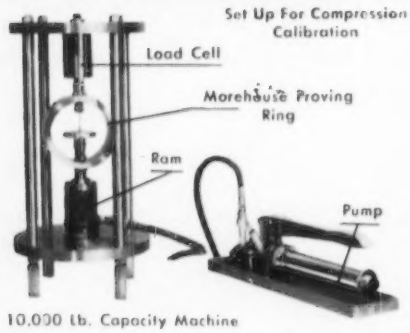
100,000 lbs.

Larger and special capacities to order



10,000 Lb. Capacity Machine

Designed to use with National Bureau of Standards Certified Morehouse Proving Rings or the Morehouse Calibrating System as the load sensing element.

The Hydraulic ram has low friction packing to insure smooth operation. The leak rate is so low that calibrations are completely unaffected by it.

The pump has an auxiliary screw piston by which the advancement of the piston can be controlled to 1/100,000 inches.

Design simplicity of the machine allows freedom to adapt it to individual requirements.

Range readily changeable by substituting different capacity proving rings.

MOREHOUSE MACHINE CO.

233 W. MARKET ST.
YORK, PA.

This new kinematic viscosity bath, completely unitized to require a minimum of table space, is the simplest and most convenient yet designed for attaining and maintaining desired test temperatures in capillary viscosimeters... while allowing perfect observation at all times.

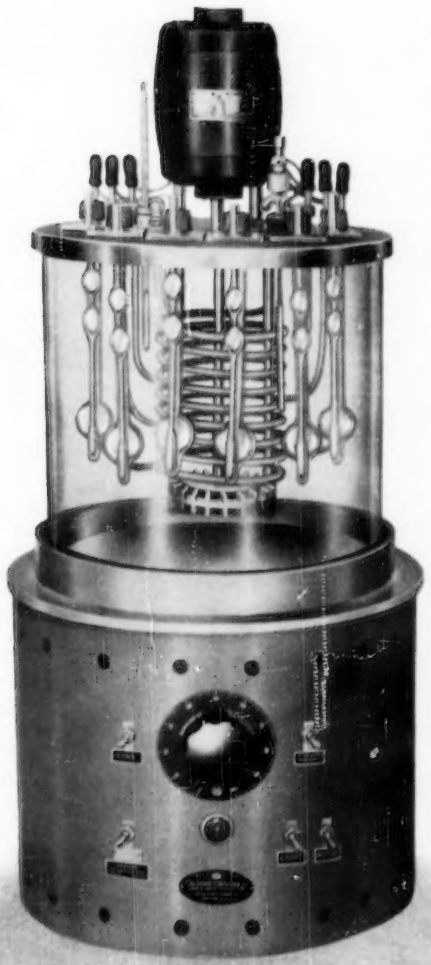
Circular fluorescent light in base illuminates entire bath and viscosimeters. Glass jar has frosted base to eliminate glare and to diffuse light over entire area.

A new type of turbine stirrer provides perfect temperature distribution, thoroughly and rapidly agitating the liquid medium, without any vortex, surface turbulence, or air entrainment to mar observations. Quickly reached operating temperatures and maximum operating temperatures are both assured by three adequately rated heaters. (The bath will hold at test temperature despite a substantial voltage drop in current supply.) Heaters and cooling coil are easily accessible, with open distribution of these elements doing away with the inconvenience of old type throttling tubes, while giving greater sensitivity and efficiency. The continuous heater is regulated by a Powerstat, to allow for perfect setting of the bath at operating temperature... almost independent of the thermostat... and with no wasteful rheostat to dissipate current energy.

A new type holder permits free insertion of the tube in a chuck-like grip without the least danger of breaking the viscosimeter or injuring the operator. The viscosimeter is then locked firmly by means of a bakelite knurled nut, which is used both for handling the assembly and for lifting the viscosimeter out of the bath without danger of burning the fingers.

A magnetic Zeitfuchs Doty (or Magna-Set) regulator of micrometer accuracy affords precise regulation to within 0.01° C ... can be quickly, easily, and conveniently set at any temperature over the entire operating range of the bath. Regulator contacts operate at maximum sensitivity and indefinite life as electronic relay draws practically no current.

The unit is equipped with a powerful, over-rated, end-thrust, ball-bearing Bodine motor... giving added assurance of long endurance.



constant temperature bath for use with capillary viscosimeters

(A.S.T.M. No. D445-46T, I.P. 71/45T)

C19605 Unitized Constant Temperature Bath for use with Capillary Viscosimeters supplied complete as illustrated, with thermoregulator and six new type tube holders, but without thermometer or viscosimeters. For 115 volts, 50-60 cycles A.C. **450.00**

In ordering, specify if bath is to be used for modified Ostwald or Ubbelohde type capillary viscosimeters.

UNITIZED KINEMATIC VISCOSITY BATH

20-26 N. MOORE STREET · DEPT. 229, N. Y. 13, N. Y.

E&G Co. ® The EMIL GREINER Co.

(Continued from page 96)

Spectrography—*Catalog 55F* of spectrographic standards, accessories, and supplies.
Spex Industries, Inc., 80-56 230th St., Queens Village 27, N. Y.

Work-holding tools—A new *catalog 9155* containing complete descriptions of an entire line of work-holding tools.
Universal Vise and Tool Co., Parma, Mich.

INSTRUMENT COMPANY NEWS

Beckman Instruments, Inc., Richmond Calif.—Donald C. Duncan has been appointed general manager of the Berkeley Div. of Beckman Instruments, Inc.

The A. W. Cash Co., Decatur, Ill.—The A. W. Cash Co. has purchased the business of the Farris Stacon Corp., Palisades Park, N. J., manufacturers of temperature control valves.

Fairchild Camera and Instrument Corp., Robbins Lane, Syosset, Long Island, N. Y.—Fairchild Camera and Instrument Corp. has established a Nuclear Instrumentation Dept. headed by nucleonics expert Dr. Harold Eugene DeBolt. Dr. DeBolt comes to Fairchild from the Nuclear Power Div. of the Navy's Bureau of Ships and the Naval Reactor Branch of the Reactor Development Div. of the Atomic Energy Commission. Louis C. Prisco has been named Sales Manager of the new department.

Fischer Scientific Co., Pittsburgh 19, Pa.—Edwin A. Wynne has been named director of research and development of the Fisher Chemical Manufacturing Div., Fair Lawn, N. J., America's largest plant devoted exclusively to laboratory-grade chemicals. Gaston Pillori moves up from assistant director to director of quality control laboratories, Fisher/Fair Lawn, and Claire C. Lindstrom moves up to chief chemist.

North American Philips Co., Inc., Mount Vernon, N. Y.—On November 1, the Research & Control Instruments Div., North American Philips Co., Inc., opened a new West Coast office at 1485 Bayshore Blvd., San Francisco. Equipment to be displayed and demonstrated in the San Francisco Office includes the complete line of Norelco X-ray diffraction and spectrographic instruments and accessories; also industrial radiographic units.

Precision Scientific Co., Chicago 47, Ill.—Paul H. Lobik has been appointed advertising manager of Precision Scientific Co., Chicago, Ill., manufacturer of laboratory research apparatus.

Soil Testing Services of California, Inc., San Francisco, Calif.—Jack H. McMinn has recently opened an office under the firm name of Soil Testing Services of California, Inc., at 1798 Filbert St., San Francisco. The firm is affiliated with Soil Testing Services, Inc., of Chicago, and will be engaged in the performance of field and laboratory investigations of soils.

Varian Associates, Palo Alto, Calif.—Varian Associates, Palo Alto electronics firm, has gone international with the formal dedication of a new manufacturing and research plant in Georgetown, Ont. Varian Associates of Canada Limited, a wholly owned subsidiary of the California firm, will produce microwave vacuum tubes and related devices.

NEWS OF LABORATORIES

Bjorksten Research Labs., Inc., Madison, Wis.—Dr. Johan Bjorksten, President of Bjorksten Research Laboratories, Inc., Madison, Wis., announces that Stuart O. Fiedler has resumed the position of technical director of Bjorksten Research Laboratories, Inc., Madison, Wis. He previously served as Vice-President and Technical Director of the company from 1945 to 1947.

Electrical Testing Labs., 2 East End Ave., New York, 21, N. Y.—Electrical Testing Labs., Inc., announces the expansion of its electronic testing facilities and services. Of particular significance is its ability to conduct tests and engineering investigations well into the microwave regions.

Foster D. Snell, Inc., New York, N. Y.—William A. Ladd, pioneer in electron microscopy has become associated with Foster D. Snell, Inc., consulting chemists and engineers.

Vitro Corp. of America, New York, N. Y.—Vitro Laboratories, a division of Vitro Corp. of America, will build a new million-dollar laboratory near Silver Spring, Md., which will replace the present leased facilities of the Silver Spring Laboratory of the division, and will allow for greatly increased expansion and many new and modern improvements.

United States Testing Co., Inc., Hoboken, N. J.—Joseph H. Sutherland has been elected to the Board of Directors of the United States Testing Co.

SLA Translation Monthly

THE SPECIAL Libraries Assn. has announced a new monthly serial, *Translation Monthly*, at a price of $5 per year. It fills a long-felt need of its members and many professional groups who are required to keep up with developments reported in foreign periodicals. It is an 8-page bibliography, listing alphabetically by author, current acquisitions to the SLA Translation Pool, located at The John Crerar Library, 86 E. Randolph St., Chicago, Ill.

The Translation Pool is a rapidly growing collection of translations deposited by Government agencies, technical societies, universities, industrial companies, and individuals. They are donated for use by others interested in the same material for their private use and research only.

Copies are made available at the regular photocopying prices of the Crerar Library. Material in the pool is from all languages but Russian, which translations are available at the Library of Congress.

OTHER SOCIETIES' EVENTS

December 26-31—**American Assn. for the Advancement of Science,** Biltmore Hotel, Atlanta, Ga.

December 28-30—**American Physical Society,** Winter Meeting, University of Southern California, Los Angeles, Calif.

December 28-30—**National Science Foundation,** Conference on Low Temperature Physics & Chemistry, Louisiana State University, Baton Rouge, La.

January 3—**Society of Applied Spectroscopy,** Hotel New Yorker, New York City.

January 9-13—**Society of Automotive Engineers,** Annual Meeting, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

January 16—**American Institute of Consulting Engineers,** Annual Meeting, The Engineers' Club, New York, N. Y.

January 17-20—**Highway Research Board,** 35th Annual Meeting, Sheraton-Park Hotel, Washington 8, D. C.

January 18-20—**Society of Plastics Engineers,** Inc., Hotel Statler, Cleveland, Ohio, 12th Annual Technical Conference.

January 23-25—**American Society of Heating and Air-Conditioning Engineers,** Annual Meeting, Sheraton-Gibson Hotel, Cincinnati, Ohio.

January 23-25—**National Concrete Masonry Assn.,** 36th Annual Convention, Roosevelt Hotel, New Orleans, La.

January 23-26—**Institute of the Aeronautical Sciences,** Annual Meeting, Hotel Sheraton Astor, New York, N. Y.

January 30-February 3—**American Institute of Electrical Engineers,** Winter General Meeting, Hotel Statler, New York, N. Y.

January 30-February 4—**American Institute of Physics,** Anniversary Celebration, Hotel New Yorker, New York, N. Y.

February 1-3—**Case Institute Studies in Operations Research,** Case Institute of Technology, 10900 Euclid Ave., Cleveland 6, Ohio.

February 7-9—**Society of Plastics Industry,** Annual Conference, Reinforced Plastics Division, Hotel Chalfonte-Haddon Hall, Atlantic City, N. J.

February 13-16—**National Sand and Gravel Assn.,** 40th Annual Convention and Biennial Show, Conrad Hilton Hotel and Chicago Coliseum, Chicago, Ill.

February 13-16—**National Ready Mixed Concrete Assn.,** 26th Annual Convention and Biennial Show, Conrad Hilton Hotel and Chicago Coliseum, Chicago, Ill.

February 20-22—**National Crushed Stone Assn.,** 39th Annual Convention and Exposition, Conrad Hilton Hotel, Chicago, Ill.

February 20-23—**American Concrete Institute,** Annual Meeting, Philadelphia, Pa.

February 20-23—**TAPPI,** 41st Annual Meeting, Commodore Hotel, New York, N. Y.

February 26-29—**American Institute of Chemical Engineers,** Los Angeles, Calif.

February 27-March 2—**Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy,** Exposition of Modern Laboratory Equipment, Wm. Penn Hotel, Pittsburgh, Pa.

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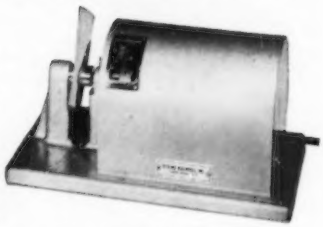

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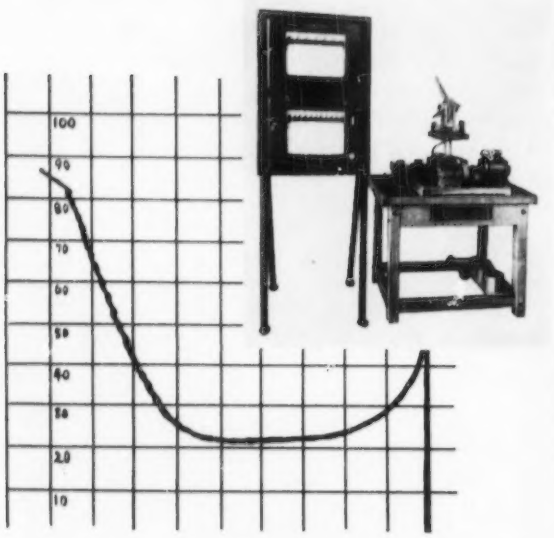

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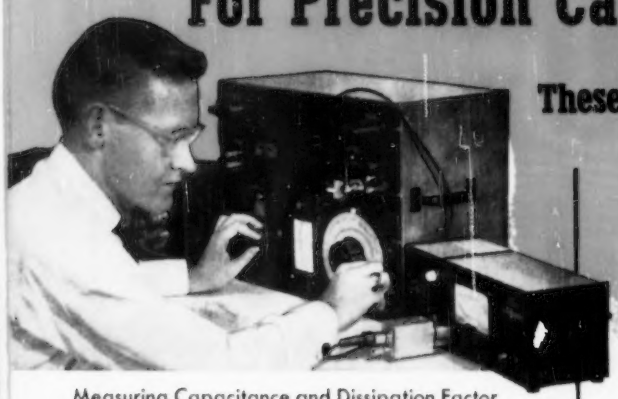

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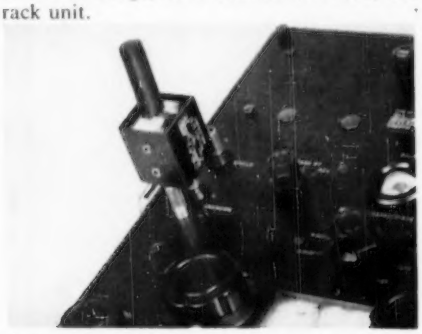

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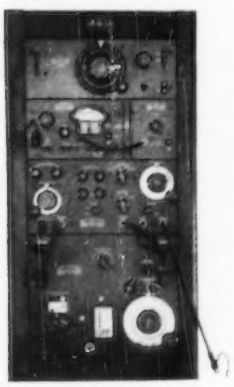

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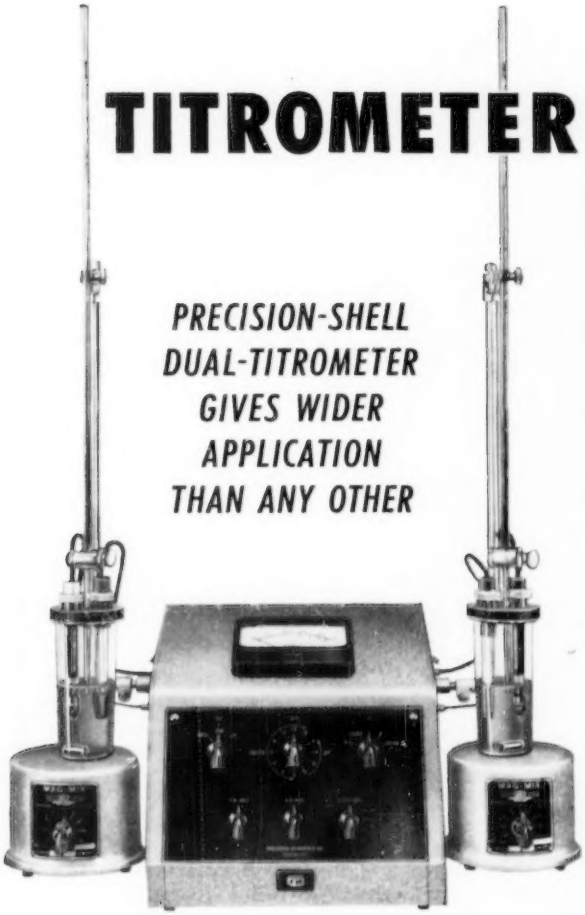

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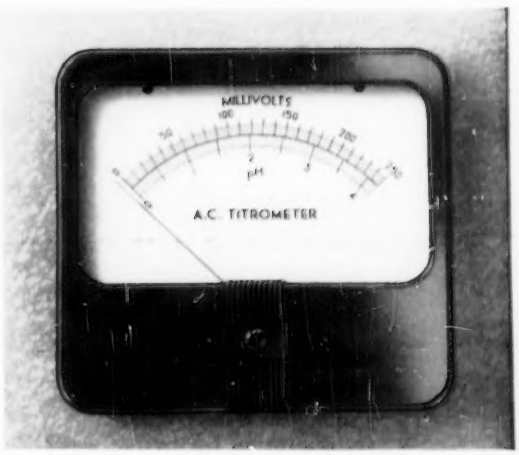

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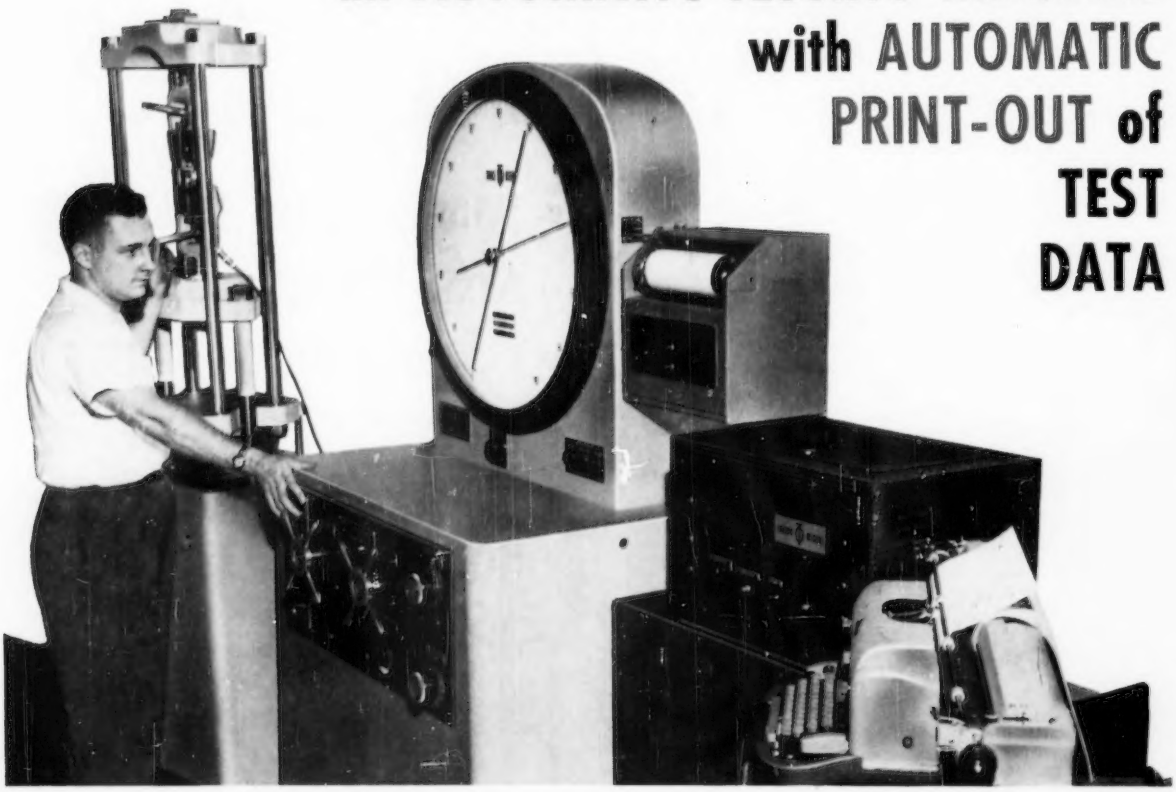

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